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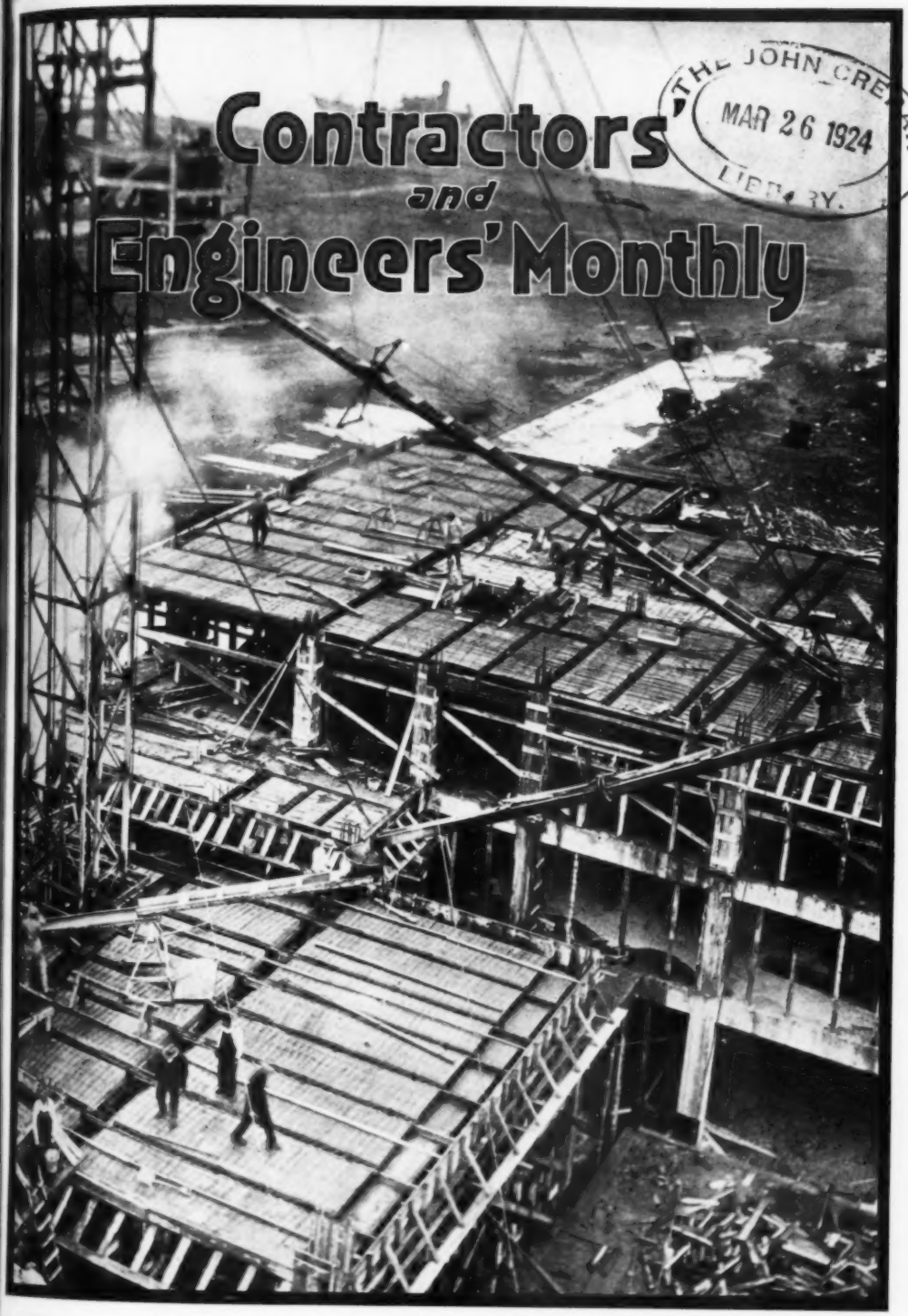
Contractors and Engineers' Monthly



The Whittier Apartments, Chicago, Ill., Under Construction

MARCH, 1924 25 Cents $1 a Year

VOL. VIII. No. 3 CONTRACTORS' & ENGINEERS' MONTHLY MARCH, 1924
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Where to Purchase

A comprehensive classification of the leading machinery and supply manufacturers arranged for the convenience of contractors, engineers and public officials who may wish to secure information about construction equipment. A star (*) before the manufacturer's name indicates that his advertisement appears in this issue.

ACETYLENE
Prest-O-Lite Co., Inc., New York.

ACETYLENE APPARATUS
Air Reduction Sales Co., New York.
Oxweld Acetylene Co., Newark, N. J.

ADDING MACHINES. (See Calculating Machines.)

AIR COMPRESSORS
*Domestic Engine & Pump Co., Shippensburg, Pa.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Chicago Pneumatic Tool Co., New York.
De Laval Steam Turbine Co., Trenton, N. J.
De La Vergne Machine Co., New York.
Fairbanks, Morse & Co., Chicago, Ill.
Gardner Governor Co., Quincy, Ill.
General Electric Co., Schenectady, N. Y.
Hardie-Tynes Mfg. Co., Birmingham, Ala.
Ingersoll-Rand Co., New York.
Nordberg Mfg. Co., Milwaukee, Wis.
Norwalk Iron Works Co., South Norwalk, Conn.
Schramm, Inc., West Chester, Pa.
Sullivan Mchy. Co., Chicago, Ill.
United Iron Works, Kansas City, Mo.
Westinghouse Trac. Brake Co., Wilmerding, Pa.
Worthington Pump & Mchy. Corp., New York.

ARC LAMPS
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

ARTESIAN WELL DRILLS AND PUMPS
Am. Well Works, Aurora, Ill.

ASBESTOS PRODUCTS
*Carey Co., Philip, Cincinnati, Ohio.
Darcold Co., Inc., New York.
Keasbey & Mattison Co., Ambler, Pa.
Mikesell Bros. Co., Wabash, Ind.
Norristown Mag. & Asb. Co., Norristown, Pa.
Sall Mountain Co., Chicago, Ill.

ASH HANDLING MACHINERY
*Haiss Mfg. Co., Geo., New York.
*International Motor Co., New York.
*Robins Conv. Belt Co., New York.
Bartlett & Snow Co., C. O., Cleveland O.
Bay City Dredge Wks., Bay City, Mich.
Brown Hoisting Mach. Co., Cleveland, Ohio.
Byers Mach. Co., Ravenna, Ohio.
Chain Belt Co., Milwaukee, Wis.
Gifford-Wood Co., Hudson, N. Y.
Green Eng. Co., East Chicago, Ind.
Guarantee Constr. Co., New York.
Jeffrey Mfg. Co., Columbus, Ohio.
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Lakewood Eng. Co., Cleveland, O.
Link-Belt Co., Chicago, Ill.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Portable Machinery Co., Passaic, N. J.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

ASPHALT PRODUCERS
*Barber Asphalt Co., Philadelphia, Pa.
*Barrett Co., New York
*Kentucky Rock Asphalt Co., Louisville, Ky.
*Pioneer Asphalt Co., Lawrenceville, Ill.
*Standard Oil Co. (Indiana), Chicago, Ill.
*Texas Co., New York.
*Warren Bros. Co., Boston, Mass.
Atlantic Refining & Asphalt Corp., Phila., Pa.
Gulf Refining Co., Pittsburgh, Pa.
Headley Good Roads Co., Philadelphia, Pa.
New Orleans Refining Co., New Orleans, La.
Sinclair Ref. Co., Chicago, Ill.
Standard Oil Co. of Calif., San Francisco, Cal.
Standard Oil Co. of La., New Orleans, La.
Standard Oil Co. of N. J., Newark, N. J.
Standard Oil Co. of N. Y., New York.
U. S. Asphalt Refining Co., New York.

ASPHALT BLOCK
Hastings Pavement Co., New York.

ASPHALT CUTTERS
Dayton Pneumatic Tool Co., Dayton, Ohio.
Chicago Pneumatic Tool Co., New York
Ingersoll-Rand Co., New York.

ASPHALT KETTLES. (See Kettles for Asphalt and Tar Heating.)

ASPHALT PLANTS, TOOLS, ETC.
*Barber Asphalt Co., Philadelphia, Pa.
*East Iron & Machine Co., Lima, Ohio.
*Littleford Bros., Cincinnati, O.
*Warren Bros. Co., Boston, Mass.
Austin Machinery Corp'n, Toledo, O.
Bacon Co., Edw. R., San Francisco, Cal.
Cummer & Son Co., F. D., Cleveland, O.
Hetherington & Berner, Indianapolis, Ind.

ASPHALT ROLLERS. (See Road and Paving Rollers.)

ASPHALT SURFACE HEATERS
*Barber Asphalt Co., Philadelphia, Pa.
*Equitable Asphalt Maint. Co., Kansas City, Mo.
Hauck Mfg. Co., Brooklyn, N. Y.

BACKFILLERS
*American Cement Mchy. Co., Inc., Keokuk, Ia.
*Koehring Co., Milwaukee, Wis.
*Pawling & Harnischfeger Co., Milwaukee, Wis.
Austin Machinery Corp'n, Toledo, O.
Byers Machine Co., Ravenna, Ohio.
Constr. Mchy. Co., Waterloo, Ia.
Oshkosh Mfg. Co., Oshkosh, Wis.
Parsons Co., Newton, Ia.
Weller Mfg. Co., Chicago, Ill.

BAR BENDERS AND CUTTERS
*Koehring Co., Milwaukee, Wis.
*Ransome Concrete Mchy. Co., Dunellen, N. J.
Buffalo Forge Co., Buffalo, N. Y.
Concrete Steel Co., New York.
Electric Welding Co., Pittsburgh, Pa.
Hinman & Co., D. A., Sandwich, Ill.
McKenna Co., Cleveland, Ohio.

BAR CHAIRS, REINFORCING
*Truscon Steel Co., Youngstown, Ohio.
Concrete Steel Co., New York.
Universal Form Clamp Co., Chicago, Ill.

BARS, IRON AND STEEL
Aborn Steel Co., Inc., New York.
Ames & Co., W., Jersey City, N. J.
Bethlehem Steel Co., Bethlehem, Pa.

Carbon Steel Co., Pittsburgh, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Franklin Steel Works, Franklin, Pa.
Gulf States Steel Co., Birmingham, Ala.
Hirsch Rolling Mill Co., St. Louis, Mo.
Illinois Steel Co., Chicago, Ill.
Inland Steel Co., Chicago, Ill.
Midvale Steel & Ordnance Co., Philadelphia, Pa.
Republic Iron & Steel Co., Youngstown, O.
St. Louis Screw Co., St. Louis, Mo.
Sweet's Steel Co., Williamsport, Pa.
Tenn. Coal, Iron & R. R. Co., Birmingham, Ala.
United Alloy Steel Corp., Canton, Ohio.

BATCH BOXES

Lakewood Eng. Co., Cleveland, O.
Western Wheeled Scraper Co., Aurora, Ill.

BELTING, RUBBER

*Goodrich Rubber Co., B. F., Akron, O.
*Robins Conv. Belt Co., New York.
Allen Mfg. Co., W. D., Chicago, Ill.
Cincinnati Rubber Mfg. Co., Cincinnati, Ohio.
Fairbanks Co., The, New York.
Goodall Rubber Co., Inc., Philadelphia, Pa.
Goodyear Tire & Rubber Co., Akron, O.
Mulconroy Co., Inc., Philadelphia, Pa.
Republic Rubber Co., Youngstown, Ohio.
Salisbury & Co., Inc., W. H., Chicago, Ill.
Southern Rubber & Belt. Co., Houston, Tex.
Union Asbestos & Rubber Co., Chicago, Ill.
U. S. Rubber Co, New York.
Voorhees Rubber Mfg. Co., Jersey City, N. J.

BINS, STORAGE

*Atlas Eng. Co., Milwaukee, Wis.
*Austin-Western Rd. Mach. Co., Chicago, Ill.
*Galion Iron Works & Mfg. Co., Galion, Ohio.
*Good Roads Mach'y Co., Kennett Square, Pa.
*Ransome Concrete Mach. Co., Dunnellen, N. J.
*Universal Road Machinery Co., Kingston, N. Y.
Austin Mfg. Co., Chicago, Ill.
Fairfield Engineering Co., Lancaster, Ohio.
Green Engineering Co., E. Chicago, Ind.
Link-Belt Co., Chicago, Ill.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Weller Mfg. Co., Chicago, Ill.

BLAST HOLE DRILLING MACHINES. (See "Well Drilling and Blast Hole Machines")

BLASTING POWDER (See Explosives)

BLOCKS AND TACKLE

Boston & Lockport Block Co., East Boston, Mass.
Broderick & Bascom Rope Co., St. Louis, Mo.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Topping Bros., New York.
Upson-Walton Co., Cleveland, Ohio.

BLOWERS, PRESSURE

American Blower Co., Detroit, Mich.
American Gas Furnace Co., New York.
Buffalo Forge Co., Buffalo, N. Y.
De Laval Steam Turbine Co., Trenton, N. J.
General Electric Co., Schenectady, N. Y.
Spencer Turbine Co., Hartford, Conn.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

BLOWPIPES

Oxweld Acetylene Co., Newark, N. J.

BLUE PRINT MACHINES

Dietzgen Co., Eugene, Chicago, Ill.
Keuffel & Esser Co., Hoboken, N. J.
Pease Co., C. F., Chicago, Ill.
Weber & Co., F., Philadelphia, Pa.
Wickes Bros., Saginaw, Mich.

BLUE PRINT AND TRACING PAPERS

Indianapolis Blue Print & S'ply Co., Ind'apolis.
Kolesch & Co., New York.

BOILERS

Abendroth & Root Mfg. Co., Newburgh, N. Y.
Ames Iron Works, Oswego, N. Y.
Babcock & Wilcox Co., New York.
Biggs Boiler Wks., Akron, Ohio.
Casey-Hedges Co., Chattanooga, Tenn.
Chandler & Taylor Co., Indianapolis, Ind.
Chatta. Boiler & Tank Co., Chattanooga, Tenn.
Cole Mfg. Co., R. D., Newnan, Ga.
Erie City Iron Works, Erie, Pa.
Fiery Mfg. Co., S., Bangor, Pa.
Hartley Boiler Works, Montgomery, Ala.
Heine Boiler Co., St. Louis, Mo.
Houston, Stanwood & Gamble Co., Cincinnati, O.
Ladd Co., Geo. T., Pittsburgh, Pa.
Leffel & Co., J., Springfield, O.
Lord & Burnham Co., Irvington, N. Y.
Murray Iron Works Co., Burlington, Ia.
New Bern Iron Wks. & Sup. Co., New Bern, N. C.
Petroleum Iron Works Co., Sharon, Pa.
Schofield Iron Works, Macon, Ga.
Traylor Engr. & Mfg. Co., Allentown, Pa.
Valk & Murdoch Co., Charleston, S. C.
Vogt Mchy. Co., Inc., Louisville, Ky.
Walsh & Weidner Boiler Co., Chattanooga, Tenn.

BOLTS, NUTS, NAILS, RIVETS, SPIKES

American Screw Co., Providence, R. I.
American Spike Co., New York.
Ames, W. & Co., Jersey City, N. J.
Bethlehem Steel Co., Bethlehem, Pa.
Buffalo Bolt Co., Buffalo, N. Y.
Clark Bros. Bolt Co., Milldale, Conn.
Erie Bolt & Nut Co., Erie, Pa.
Foster Bolt & Nut Mfg. Co., Cleveland, Ohio.
Inland Steel Co., Chicago, Ill.
Lamson & Sessions Co., Cleveland, Ohio.
Maryland Bolt & Forge Co., Baltimore, Md.
Milton Mfg. Co., Milton, Pa.
Neely Nut & Bolt Co., Pittsburgh, Pa.
Oliver Iron & Steel Corp'n, Pittsburgh, Pa.
Pittsburgh Screw & Bolt Co., Pittsburgh, Pa.
Progressive Mfg. Co., Torrington, Conn.
Republic Iron & Steel Co., Youngstown, O.
Rhode Island Tool Co., Providence, R. I.
Russell, Bursdall & Ward Co., Port Chester, N. Y.
St. Louis Screw Co., St. Louis, Mo.
Scranton Bolt & Nut Co., Scranton, Pa.
Star Exp. Bolt Co., New York.
Sweet's Steel Co., Williamsport, Pa.

BRACES, TRENCH

Channon Mfg. Co., Jas. H., Chicago, Ill.
Duff Mfg. Co., Pittsburgh, Pa.
Kalamazoo Fdry. & Mach. Co., Kalamazoo, Mich.
Waldo Bros. & Bond Co., Boston, Mass.

BRASS GOODS

*Union Water Meter Co., Worcester, Mass.
Glauber Brass Mfg. Co., Cleveland, O.
Haydenville Co., Haydenville, Mass.
Hays Mfg. Co., Erie, Pa.
Mueller Mfg. Co., H., Decatur, Ill.
United Brass Mfg. Co., Cleveland, O.

BREAKERS, CONCRETE

Buckeye Traction Ditcher Co., Findlay, O.
Chicago Pneumatic Tool Co., New York.
Ingersoll-Rand Co., New York City

BRICK, PAVING (See Paving Brick)

BRIDGES AND BUILDINGS, STEEL

*Blaw-Knox Co., Pittsburgh, Pa.
*Frederick Snare Corporation, New York.
American Bridge Co., New York.
Bellefontaine Bridge & Steel Co., Bellefontaine, O.
Belmont Iron Works, Philadelphia, Pa.
Berlin Constr. Co., Berlin, Conn.
Bethlehem Steel Co., Bethlehem, Pa.
Boston Bridge Works, Boston, Mass.
Central States Bridge Co., Indianapolis, Ind.
Champion Bridge Co., Wilmington, O.
Chesapeake Iron Works, Baltimore, Md.
Chicago Bridge & Iron Works, Chicago, Ill.
Clinton Bridge Wks., Clinton, Iowa.
Eastern Bridge & Struc. Co., Worcester, Mass.
Flour City Orn. Iron Co., Minneapolis, Minn.
Fort Pitt Bridge Works, Pittsburgh, Pa.
Ingalls Iron Works Co., Birmingham, Ala.
Inter. Steel & Iron Co., Evansville, Ind.
Lewis-Hall Iron Wks., Detroit, Mich.
Louisville Bridge & Iron Co., Louisville, Ky.
McClintic Marshall Co., Pittsburgh, Pa.
Milwaukee Bridge Co., Milwaukee, Wis.

*Indicates that the manufacturer carries an advertisement. See index facing inside back cover.

Minn. Steel & Mchy. Co., Minneapolis, Minn
Missouri Vy. Bdge. & Iron Co., Leavenworth, Kan.
Morava Constr. Co., Chicago, Ill.
Mt. Vernon Bridge Co., Mt. Vernon, Ohio.
Penn. Bridge Co., Beaver Falls, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Richmond Struc. Steel Co., Richmond, Va.
Riverside Bridge Co., Martins Ferry, O.
Virginia Bridge & Iron Co., Roanoke, Va.
Wisc. Bridge & Iron Co., North Milwaukee, Wis.

BRONZE TABLETS

Flour City Orn. Iron Co., Minneapolis, Minn.
Imperial Brass Mfg. Co., Chicago, Ill.
Mott Iron Wks., J. L., New York

BROOMS (See Street Sweeping Brooms)

BUCKETS, AUTOMATIC DUMPING

*Littleford Bros., Cincinnati, O
Lakewood Engineering Co., Cleveland, O.
Stuebner Iron Works, G. L., Long Island City,

BUCKETS, CLAM SHELL

*Blaw-Knox Co., Pittsburgh, Pa.
*Haiss Mfg. Co., Geo., New York.
Brown Hoisting Mchy. Co., Cleveland, O.
Browning Co., Cleveland, O.
Byers Mach. Co., J. F., Ravenna, O.
Coleman Co., F. A., Cleveland, O.
Hayward Co., New York.
Industrial Works, Bay City, Mich.
Kiesler Co., J. F., Chicago, Ill.
Lakewood Engineering Co., Cleveland, O.
Link-Belt Co., Chicago, Ill.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Orton & Steinbrenner Co., Chicago, Ill.
Owen Bucket Co., Cleveland, Ohio
Williams Co., G. H., Erie, Pa.

BUCKETS, CONCRETE

*Koppel Ind. Car & Equip. Co., Koppel, Pa.
*Ransome Concrete Mchy. Co., Dunellen, N. J.
Insley Mfg. Co., Indianapolis, Ind.
Lakewood Engineering Co., Cleveland, O.
Rochester Can Co., Rochester, N. Y.
Smith Co., T. L., Milwaukee, Wis.
Union Iron Works, Inc., Hoboken, N. J.
Weller Mfg. Co., Chicago, Ill.

BUCKETS, DRAGLINE

*Sauerman Bros., Chicago, Ill.
Austin Machinery Corp'n, Toledo, O.
Brown Hoisting Mach. Co., Cleveland, O.
Bucyrus Co., So. Milwaukee, Wis.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Hayward Co., New York.
Industrial Works, Bay City, Mich.
Link-Belt Co., Chicago, Ill.
Monighan Machine Co., Chicago, Ill.

BUCKETS, DREDGING AND EXCAVATING

*Blaw-Knox Co., Pittsburgh, Pa.
*Haiss Mfg. Co., Inc., Geo., New York.
Austin Machinery Corp'n, Toledo, O.
Brown Hoisting Mach. Co., Cleveland, O.
Browning Co., Cleveland, O.
Hayward Co., New York.
Kiesler Co., J. F., Chicago, Ill.
Lakewood Eng. Co., Cleveland, O.
Mead-Morrison Mfg. Co., East Boston, Mass.
Owen Bucket Co., Cleveland, Ohio.
Williams Co., G. H., Erie, Pa.

BUCKETS, ORANGE PEEL

Hayward Co., New York.
Industrial Works, Bay City, Mich.
Kiesler Co., J. F., Chicago, Ill.
McMyler Interstate Co., Cleveland, O.
Mead-Morrison Mfg. Co., East Boston, Mass.
Orton & Steinbrenner Co., Chicago, Ill.
Vulcan Iron Works, Jersey City, N. J.

BUILDERS' HARDWARE

Corbin, P. & F., New Britain, Conn.
Reading Hardware Co., Reading, Pa.
Russell & Erwin Mfg. Co., New Britain, Conn.
Sargent & Co., New Haven, Conn.
Stanley Works, New Britain, Conn.
Yale & Towne Mfg. Co., New York.

BUILDINGS, STEEL (See Bridges and Buildings)

BUNKS AND COTS

Fort Pitt Bedding Co., Pittsburgh, Pa.
Haggard & Marcusson Co., Chicago, Ill.
Southern Rome Co., Baltimore, Md.

CABLES (See Wire and Cables)

CABLEWAYS

*Sauerman Bros., Chicago, Ill.
*Street Bros. Mach. Wks., Chattanooga, Tenn.
Broderick & Bascom Rope Co., St. Louis, Mo.
Flory Mfg. Co., S., Bangor, Pa.
Lidgerwood Manufacturing Co., New York.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Roebling Sons Co., J. A., Trenton, N. J.
Waterbury Co., New York.

CAISSONS

American Bridge Co., New York.
Foundation Co., New York.
Bethlehem Steel Co., Bethlehem, Pa.
O'Rourke Eng. Constr. Co., New York.
Petroleum Iron Works Co., Sharon, Pa.

CALCIUM CHLORIDE FOR ROADS

*Dow Chemical Co., Midland, Mich.
*Semet-Solvay Co., Syracuse, N. Y.
Carbondale Calcium Co., Carbondale, Pa.

CALCULATING MACHINES

Burroughs Adding Machine Co., Detroit, Mich.
Dalton Adding Mach. Co., Cincinnati, O.
Felt & Tarrant Mfg. Co., Chicago, Ill.
Marchant Calc. Machine Co., Oakland, Cal.
Monroe Calculating Machine Co., Orange, N. J

CANS FOR GARBAGE AND STREET REFUSE

*Rochester Can Co., Rochester, N. Y.
American Can Co., New York.
Butler Mfg. Co., Minneapolis, Minn.
Economy Baler Co., Ann Arbor, Mich.
Safety Sanitary Rubbish Box Co., Columbus, O
Solar-Sturges Mfg. Co., Chicago, Ill.
Steel Basket Co., Cedar Rapids, Iowa.

CARS, INDUSTRIAL V. DUMPING

*Insley Mfg. Co., Indianapolis, Ind.
*Koppel Ind. Car & Equip. Co., Koppel, Pa.
Austin Machinery Corp'n, Toledo, O.
Atlas Car & Mfg. Co., Cleveland, O.
Chase Fdry. & Mfg. Co., Columbus, O.
Easton Car & Constr. Co., New York.
Hunt Co., C. W., W. New Brighton, N. Y.
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Lakewood Engineering Co., Cleveland, O.
Light Ry. Equipment Co., Philadelphia, Pa.
Oliver Mfg. Co., W. J., Knoxville, Tenn.
Stuebner Iron Works, G. L., L. I. City, N. Y.
United Iron Works, Kansas City, Mo.
Weller Mfg. Co., Chicago, Ill.
Whiting Corp'n, Harvey, Ill.

CARTS, CONCRETE

*Insley Mfg. Co., Indianapolis, Ind.
*Littleford Bros., Cincinnati, O.
*Ransome Concrete Mchy. Co., Dunellen, N. J.
Akron Barrow Co., Cleveland, Ohio.
Etnyre & Co., E. D., Oregon, Ill.
Gray Iron Fdry. Co., Reading, Pa.
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Lakewood Engineering Co., Cleveland, O.
Lee Trailer & Body Co., Chicago, Ill.
Smith Co., T. L., Milwaukee, Wis.
Sterling Wheelbarrow Co., Milwaukee, Wis.
Toledo Wheelbarrow Co., Toledo, Ohio.

CAST IRON PIPE (See Pipe, Cast Iron)

CASTINGS, STREET AND SEWER

*Central Foundry Co., New York.
*Clark Co., H. W., Mattoon, Ill.
*U. S. Cast Iron Pipe & Fdry. Co., Burlington, N. J.

Canton Foundry & Machine Co., Canton, O.
Casey-Hedges Co., Chattanooga, Tenn.
Clow & Sons, J. B., Chicago, Ill.
Dee Co., W. E., Chicago, Ill.
Portable Machinery Co., Passaic, N. J.
Foundry Mfg. Co., St. Albans, Vt.
Klauer Mfg. Co., Dubuque, Iowa.
Madison Foundry Co., Cleveland, O.
Pechstein Iron Works, Keokuk, Ia.
Sessions Foundry Co., Bristol, Conn.
South Bend Foundry Co., South Bend, Ind.

CATCH BASINS (See Castings, Street and Sewer)

CATCH BASIN CLEANING APPARATUS

*International Motor Co., New York.
Elgin Sales Corp., New York.

CAULKING MACHINERY AND TOOLS

Helwig Mfg. Co., St. Paul, Minn.
Ingersoll-Rand Co., New York.
Mueller Mfg. Co., H., Decatur, Ill.

CEILINGS, METAL

Berger Mfg. Co., Canton, O.
Canton Art Metal Co., Canton, O.
Newport Rolling Mill Co., Newport, Ky.
Klauer Mfg. Co., Dubuque, Iowa.
Meeker & Co., Geo. L., Evansville, Ind.
Milwaukee Corrugating Co., Milwaukee, Wis.
Wheeling Corrugating Co., Wheeling, W. Va.

CEMENT

*Pennsylvania Cement Co., New York
Ætna Portland Cement Co., Detroit, Mich.
Allentown Portland Cement Co., Allentown, Pa.
Alpha Portland Cement Co., Easton, Pa.
Ash Grove Lime and Portland Cement Co., Kansas City, Mo.
Atlas Portland Cement Co., New York.
Bath Portland Cement Co., Philadelphia, Pa.
Beaver Portland Cement Co., Portland, Ore.
Bessemer Limestone and Cement Co., Youngstown, O.
Bonner Portland Cement Co., Kansas City, Mo.
Canada Cement Co., Ltd., Montreal, Canada.
Cape Girardeau Portland Cement Co., Cape Girardeau, Mo.
Castalia Portland Cement Co., Pittsburgh, Pa.
Clinchfield Portland Cement Corp., Kingsport, Tenn.
Colorado Portland Cement Co., Denver, Colo.
Continental Portland Cement Co., St. Louis, Mo.
Coplay Cement Manufacturing Co., Coplay, Pa.
Cowell Portland Cement Co., San Francisco, Cal.
Crescent Portland Cement Co., Wampum, Pa.
Dewey Portland Cement Co., Kansas City, Mo.
Dexter Portland Cement Co., Nazareth, Pa.
Diamond Portland Cement Co., Cleveland, Ohio.
Dixie Portland Cement Co., Chattanooga, Tenn.
Edison Portland Cement Co., New York.
Fredonia Portland Cement Co., Fredonia, Kans.
Giant Portland Cement Co., Philadelphia, Pa.
Gilmore Portland Cement Corp., Gilmore City, Iowa.
Glens Falls Portland Cement Co., Glens Falls, N. Y.
Golden State Portland Cement Co., Los Angeles, Cal.
Gulf States Portland Cement Co., Demopolis, Ala.
Hawkeye Portland Cement Co., Des Moines, Ia.
Helderberg Cement Co., Albany, N. Y.
Hercules Cement Corp., Philadelphia, Pa.
Indiana Portland Cement Co., Indianapolis, Ind.
International Portland Cement Co., Ltd., Spokane, Wash.
Knickerbocker Portland Cement Co., Inc., New York.
Kosmos Portland Cement Co., Louisville, Ky.
Lawrence Portl'd Cement Co., Northampton, Pa.
Lehigh Portland Cement Co., Allentown, Pa.
Louisville Cement Co., Louisville, Ky.
Marquette Cement Mfg. Co., Chicago, Ill.
Missouri Portland Cement Co., St. Louis, Mo.
Monarch Cement Co., Humboldt, Kans.
Nazareth Cement Co., Nazareth, Pa.
Newaygo Portland Cement Co., Newaygo, Mich.
Nebraska Cement Co., Denver, Colo.
New Egyptian Portland Cement Co., Fenton, Mich.
New York & New England Cement & Lime Co., New York.
Northwestern States Portland Cement Co., Mason City, Ia.
Ogden Portland Cement Co., Ogden, Utah.
Oklahoma Portland Cement Co., Denver, Colo.
Old Mission Portland Cement Co., San Francisco, Cal.
Olympic Portl'd Cement Co., Ltd., Seattle, Wash.
Oregon Portland Cement Co., Portland, Ore.
Pacific Portland Cement Co., San Francisco, Cal.
Peerless Portland Cement Co., Union City, Mich.
Peninsular Portland Cement Co., Cement City, Mich.
Penn-Allen Cement Co., Allentown, Pa.
Petoskey Portland Cement Co., Petoskey, Mich.
Phœnix Portland Cement Co., Nazareth, Pa.
Portland Cement Co. of Utah, Salt Lake City, Utah.
Pyramid Portland Cement Co., Des Moines, Ia.
Riverside Portl'd Cement Co., Los Angeles, Cal.
San Antonio Portland Cement Co., San Antonio, Tex.
Sandusky Cement Co., Cleveland, Ohio.
Santa Cruz Portland Cement Co., San Francisco, Cal.
Security Cement and Lime Co., Hagerstown, Md.
Signal Mountain Portland Cement Co., Chattanooga, Tenn.
Southern States Portland Cement Co., Rockport, Ga.
Southwest'n Portland Cement Co., El Paso, Tex.
Standard Portland Cement Corp., San Francisco, Calif.
Superior Portland Cement Co., Seattle, Wash.
Texas Portland Cement Co., Dallas, Tex.
Three Forks Portland Cement Co., Denver, Colo.
Tidewater Portland Cement Co., Baltimore, Md.
Trinity Portland Cement Co., Dallas, Tex.
Union Portland Cement Co., Ogden, Utah.
United States Potash Co., Los Angeles, Cal.
U. S. Portland Cement Co., Denver, Colo.
Universal Portland Cement Co., Chicago, Ill.
Vulcanite Portland Cement Co., Philadelphia, Pa.
Wabash Portland Cement Co., Detroit, Mich.
Wellston Iron Furnace Co., Jackson, Ohio.
Western States Portland Cement Co., Independence, Kans.
Whitehall Cement Mfg. Co., Philadelphia, Pa.
Wolverine Portl'd Cement Co., Coldwater, Mich.
Wyandotte Portland Cement Co., Detroit, Mich.

CEMENT GUNS

Cement Gun Co., Allentown, Pa.

CEMENT INSPECTION (See Inspecting Laboratories)

CEMENT TOOLS

*Abrams Cement Tool Co., Detroit, Mich.

CHAINS

American Chain Co., Inc., Bridgeport, Conn.
Chain Belt Co., Milwaukee, Wis.
Columbus McKinnon Chain Co., Columbus, O.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago, Ill.
Niagara Metal Stamp Corp., Niagara Falls, N. Y.
U. S. Chain & Forge Co., Pittsburgh, Pa.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

CHEMICALS FOR WATER PURIFICATION

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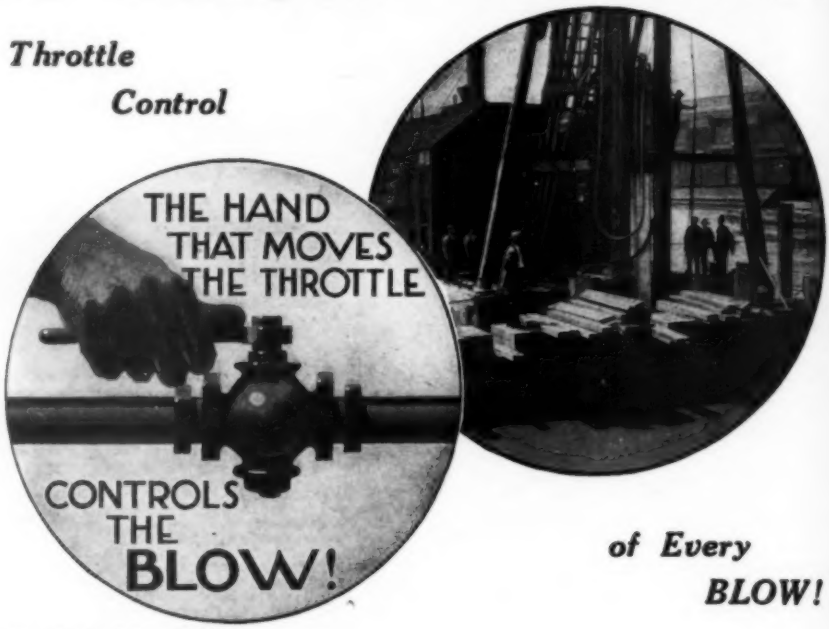

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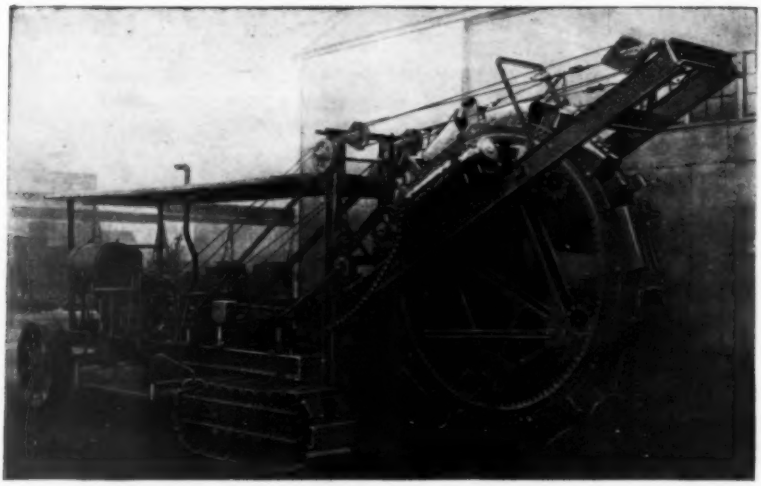

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Atlas Dryer Co., Cleveland, O.
Bartlett & Snow Co., C. O., Cleveland, O.
Cummer & Son Co., F. D., Cleveland, O.
Ruggles-Coles Eng. Co., New York.
Variety Iron & Steel Works, Cleveland, O.

DRYERS, SAND AND GRAVEL

*Littleford Bros., Cincinnati, Ohio.

DUMP BODIES FOR MOTOR TRUCKS

*Heil Company, Milwaukee, Wis.
*Insley Mfg. Co., Indianapolis, Ind.
*International Motor Co., New York.
*Littleford Bros., Cincinnati, O.
*Wood Hydr. Hoist & Body Co., Detroit, Mich.
(Horizontal Hydraulic Hoist Co., Detroit, Mich.)
Archer Iron Works, Chicago, Ill.
Auto Truck Steel Body Co., Chicago, Ill.
Columbian Steel Tank Co., Kansas City, Mo.
Columbia Wagon & Body Co., Columbia, Pa.
Griscom-Russell Co., New York
Jennings Automatic Dump Body, Roanoke, Va.
Lee Trailer & Body Co., Chicago, Ill
Pechstein Iron Works, Keokuk, Iowa.
Simplex Mfg. Co., Conneautville, Pa.
Van Dorn Iron Wks., Cleveland, Ohio.

DUMP CARTS AND WAGONS, HORSE DRAWN

*Austin Western Road Mchy. Co., Chicago, Ill.
*Russell Grader Mfg. Co., Minneapolis, Minn.
Acme Road Machinery Co., Frankfort, N. Y.
Acme Wagon Co., Emigsville, Pa.
Austin Mfg. Co., Chicago, Ill.
Columbia Wagon & Body Co., Columbia, Pa.
Convertible Wagon-Trailers, Inc., Buffalo, N. Y.
Eagle Wagon Works, Auburn, N. Y.
Holzbog & Bro., Geo. H., Jeffersonville, Ind.
Stroud & Co., Omaha, Nebr.
Tiffin Wagon Co., Tiffin, Ohio.
Watson Products Corp., Canastota, N. Y.
Western Wheeled Scraper Co., Aurora, Ill.

DUST LAYING (CALCIUM CHLORIDE)

*Dow Chemical Co., Midland, Mich.
*Semet-Solvay Co., Syracuse, N. Y.
Carbondale Calcium Co., Carbondale, Pa.

DYNAMITE (See Explosives)

EJECTORS, SEWAGE

Pacific Flush Tank Co., Chicago, Ill.
Yeomans Bros. Co., Chicago, Ill.

ELECTRIC GENERATORS AND MOTORS

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Crocker-Wheeler Co., Ampere, N. J.
Fairbanks, Morse & Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Ideal Elec. & Mfg. Co., Mansfield, O.
Lincoln Electric Co., Cleveland, O.
Robbins & Myers Co., Springfield, O.
Triumph Electric Co., Cincinnati, O.
Wagner Elec. Mfg. Co., St. Louis, Mo.
Western Electric Co., New York.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

ELECTRIC LAMPS

General Electric Co., Schenectady, N. Y.
Westinghouse Lamp Co., New York.

ELECTRIC LIGHTING PLANTS

*Climax Engineering Co., Clinton, Ia.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Fairbanks, Morse & Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Universal Motor Co., Oshkosh, Wis.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.
Western Electric Co., New York.

ELECTRIC SUPPLIES, METERS, ETC.

Bissell Co., F., Toledo, Ohio.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

ELECTRIC TRANSFORMERS

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Kuhlman Electric Co., Bay City, Mich.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa

ELECTRIC WIRES AND CABLES. (See "Wire and Cable")

ELEVATORS, BUCKET

*Atlas Eng. Co., Milwaukee, Wis.
*Austin Western Road Machy. Co., Chicago, Ill.
*Good Roads Mach'y Co., Kennett Square, Pa.
*Haiss Mfg. Co., Geo., New York.
*Littleford Bros., Cincinnati, Ohio.
*Robins Conv. Belt Co., New York.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Universal Road Machinery Co., Kingston, N. Y.
Austin Mfg. Co., Chicago, Ill.
Bartlett & Snow Co., C. O., Cleveland, Ohio.
Chain Belt Co., Milwaukee, Wis.
Fairfield Engineering Co., Lancaster, Ohio.
Gifford-Wood Co., Hudson, N. Y.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago, Ill.
Olson & Co., Sam'l, Chicago, Ill.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.
Worthington Pump & Mchy. Corp., New York.

ELEVATORS, PASSENGER, FREIGHT, ETC.

Albro-Clem Elevator Co., Philadelphia, Pa.
Amer. Elevator & Mach. Co., Louisville, Ky.
Bay State Elevator Co., Springfield, Mass.
Haughton Elev. & Mach. Co., Toledo, Ohio.
Kaestner & Hecht Co., Chicago, Ill.
Llewellyn Iron Works, Los Angeles, Cal.
Montgomery Elevator Co., Moline, Ill.
Otis Elevator Co., New York.
Ridgeway & Son Co., C., Coatesville, Pa.
See Elec. Elevator Co., A. B., New York.
Speidel, J. G., Reading, Pa.
Warner Elevator Mfg. Co., Cincinnati, O.
Warsaw Elevator Co., Warsaw, N. Y.

ENGINES, GAS AND GASOLINE

*Climax Engineering Co., Clinton, Ia.
*Hercules Corpn., Evansville, Ind.
*Holt Mfg. Co., Peoria, Ill.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Buda Co., Harvey, Ill.
C. H. & E. Mfg. Co., Milwaukee, Wis.
Charter Gas Eng. Co., Sterling, Ill.
Chicago Pneumatic Tool Co., New York.
Domestic Engine & Pump Co., Shippensburg, Pa.
Evinrude Motor Co., Milwaukee, Wis.
Fairbanks, Morse & Co., Chicago, Ill.
Foos Gas Engine Co., Springfield, Ohio.
Fuller & Johnson Mfg. Co., Madison, Wis.
Gade Bros. Mfg. Co., Iowa Falls, Iowa.
Nelson Bros. Co., Saginaw, Mich.
"New-Way" Motor Co., Lansing, Mich.
Novo Engine Co., Lansing, Mich.
Universal Motor Co., Oshkosh, Wis.
Weber Engine Co., Kansas City, Mo.
Wellman-Seaver-Morgan Co., Cleveland, O.
Worthington Pump & Mchy. Corp., New York.

ENGINES, OIL

DIESEL

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Busch-Sulzer Bros.-Diesel Eng. Co., St. Louis, Mo.
Dodge Sales & Eng. Co., Mishawaka, Ind.
Fulton Iron Works Co., St. Louis, Mo.
Hadfield-Penfield Steel Co., Bucyrus, Ohio.
McIntosh & Seymour Corp., Auburn, N. Y.
Nordberg Mfg. Co., Milwaukee, Wis.
Western Machy. Co., Los Angeles, Cal.

SEMI-DIESEL

Anderson Fdry. & Mach. Co., Anderson, Ind.
Bessemer Gas Eng. Co., Grove City, Pa.
Buckeye Machinery Co., Lima, O.
Charter Gas Eng. Co., Sterling, Ill.
Chicago Pneumatic Tool Co., New York
De La Vergne Machine Co., New York
Evinrude Motor Co., Milwaukee, Wis.
Fairbanks, Morse & Co., Chicago, Ill.
Foos Gas Engine Co., Springfield, O.
Ingersoll-Rand Co., New York.
Midwest Engine Co., Indianapolis, Ind.
Muncie Oil Eng. Co., Muncie, Ind.
Nordberg Mfg. Co., Milwaukee, Wis.
St. Mary's Oil Eng. Co., St. Charles, Mo.
Stover Mfg. & Engine Co., Freeport, Ill.
Taylor Machine Co., Cleveland, O.
Weber Engine Co., Kansas City, Mo.
Worthington Pump & Mchy. Corp., New York.

ENGINES, PUMPING

*Climax Engineering Co., Clinton, Ia.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Hooven, Owen, Rentschler Co., Hamilton, O.
Murray Iron Wks., Burlington, Ia.
Nordberg Mfg. Co., Milwaukee, Wis.
Worthington Pump & Mchy. Corp., New York.

ENGINES, STEAM

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Dake Engine Co., Grand Haven, Mich.
Erie-Ball Engine Co., Pittsburgh, Pa.
Erie Pump & Engine Co., Medina, N. Y.
Filer-Stowell Co., Milwaukee, Wis.
Hardie-Tynes Mfg. Co., Birmingham, Ala.
Leffel Co., J., Springfield, O.
Morris Machine Works, Baldwinsville, N. Y.
Murray Iron Works Co., Burlington, Ia.
Nordberg Mfg. Co., Milwaukee, Wis.
Startevant Co., B. F., Hyde Park, Boston, Mass.
Vilter Mfg. Co., Milwaukee, Wis.

EXCAVATING MACHINERY. (See Names Under Excavators, also Steam Shovels)

EXCAVATORS, CABLEWAY

Bucyrus Co., South Milwaukee, Wis.
Lidgerwood Mfg. Co., New York.

EXCAVATORS, DITCH AND TRENCH

*Insley Mfg. Co., Indianapolis, Ind.
*Keystone Driller Co., Beaver Falls, Pa.
*Osgood Co., The, Marion, O.
*Pawling & Harnischfeger Co., Milwaukee, Wis.
*Russell Grader Mfg. Co., Minneapolis, Minn.
American Hoist & Derrick Co., St. Paul, Minn.
Austin Machinery Corp'n, Toledo, O.
Bay City Dredge Works, Bay City, Mich.
Byers Machine Co., Ravenna, Ohio.
Ball Engine Co., Erie, Pa.
Buckeye Traction Ditcher Co., Findlay, Ohio.
Bucyrus Co., South Milwaukee, Wis.
Clyde Iron Works Sales Co., Duluth, Minn.
Economy Excavator Co., Iowa Falls, Ia.
Erie Steam Shovel Co., Erie, Pa.
Fairbanks Steam Shovel Co., Marion, O.
Hayward Co., The, New York City.
Marion Steam Shovel Co., Marion, O.
Monighan Machine Co., Chicago, Ill.
Parsons Co., Newton, Ia.
Topping Machy. Co., Chas. T., Dayton, O.

EXCAVATORS, DRAG-LINE

*Bay City Dredge Works, Bay City, Mich.
*Osgood Co., The, Marion, O.
*Pawling & Harnischfeger Co., Milwaukee, Wis.
*Sauerman Bros., Chicago, Ill.
Austin Machinery Corp'n, Toledo, O.
Browning Co., Cleveland, O.
Bucyrus Co., South Milwaukee, Wis.
Byers Machine Co., Ravenna, Ohio.
Clyde Iron Works Sales Co., Duluth, Minn.
Economy Excavator Co., Iowa Falls, Ia.
Erie Steam Shovel Co., Erie, Pa.
Gade Excavator Works, C. L., Iowa Falls, Iowa
Hayward Co., New York.
Industrial Works, Bay City, Mich.
Link-Belt Co., Chicago, Ill.
Marion Steam Shovel Co., Marion, O.
Monighan Machine Co., Chicago, Ill.
Parsons Co., Newton, Ia.
Smith Co., T. L., Milwaukee, Wis.

EXPANDED METAL

*Truscon Steel Co., Youngstown, O.
Berger Mfg. Co., Canton, O.
Consolidated Expanded Metal Co., Braddock, Pa.
Corrugated Bar Co., Inc., Buffalo, N. Y.
Northwestern Expanded Metal Co., Chicago, Ill.
Youngstown Pressed Steel, Co., Warren, O.

EXPANSION JOINT MATERIAL

*Barber Asphalt Co., Philadelphia, Pa.
*Carey Co., Philip, Cincinnati, Ohio.
*Pioneer Asphalt Co., Lawrenceville, Ill.
*Texas Company, New York.
*Truscon Steel Co., Youngstown, O.
*Waring-Underwood Co., Philadelphia, Pa.
Asphalt Products Co., Coatesville, Pa.
Barrett Co., New York.
Servicised Products Co., Chicago, Ill.

EXPLOSIVES

Atlas Powder Co., Wilmington, Del.
Du Pont de Nemours & Co., E.I., Wilmington, Del.
Giant Powder Co., Cons., San Francisco, Cal.
Hercules Powder Co., Wilmington, Del.

FENCING

Adrian Wire Fence Co., Adrian, Mich.
American Steel & Wire Co., Chicago, Ill.
Anchor Post Iron Works, New York.
Cyclone Fence Co., Waukegan, Ill.
Frost-Superior Fence Co., Cleveland, O.
Indiana Steel & Wire Co., Muncie, Ind.
Nitselman Bros., Muncie, Ind.
Michigan Wire Fence Co., Adrian, Mich.
Page Steel & Wire Co., Bridgeport, Conn.
Pittsburgh Steel Co., Pittsburgh, Pa.
Stewart Iron Works Co., Cincinnati, Ohio.
Texas Cyclone Fence Co., Fort Worth, Tex.
Wickwire Spencer Steel Corp., New York.
Youngstown Sheet & Tube Co., Youngstown, O.

FILING EQUIPMENT, STEEL

Art Metal Constr. Co., Jamestown, N. Y.
Berger Mfg. Co., Canton, O.
General Fireproofing Co., Youngstown, O.
Van Dorn Iron Works, Cleveland, O.

FILTERS, OIL

Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Wayne Tank & Pump Co., Ft. Wayne, Ind.

FILTERS, WATER

American Water Softener Co., Philadelphia, Pa.
Graver Corporation, E. Chicago, Ind.
International Filter Co., Chicago, Ill.
N. Y. Continental Jewel Filtr. Co., Nutley, N. J.
Norwood Engineering Co., Florence, Mass.
Roberts Filter Co., Darby, Pa.
Scaife & Sons Co., W. B., Pittsburgh, Pa.

FIRE ALARM SYSTEMS

Gamewell Fire Alarm Tel. Co., Newton Upper Falls, Mass.

FIRE ALARM SIRENS

Erick Elec. Siren Co., St. Paul, Minn.
Federal Sign System, Chicago, Ill.
Hendrie & Bolthoff Mfg. & Sup. Co., Denver, Col.
Interstate Machine Prod. Co., Rochester, N. Y.
Sireno Co., Stapleton, N. Y.
Union Water Meter Co., Worcester, Mass.

FIRE APPARATUS, MOTOR

*International Motor Co., New York.
Ahrens-Fox Fire Engine Co., Cincinnati, O.
American-La France Fire Eng. Co., Elmira, N. Y.
Brockway Motor Fire App. Co., Cortlandt, N. Y.
Northern Fire Apparatus Co., Minneapolis, Minn.
Foamite-Childs Corp., Utica, N. Y.
Pirsch & Sons Co., Peter, Kenosha, Wis.
Prospect Mfg. Co., Prospect, O.
Seagrave Co., Columbus, O.
Stutz Fire Engine Co., Indianapolis, Ind.
Waterous Fire Engine Co., St. Paul, Minn.

FIRE EXTINGUISHERS, CHEMICAL

American-La France Fire Eng. Co., Elmira, N. Y.
Cross Mfg. Co., C. J., Inc., New York.
Foamite-Childs Co., Utica N. Y.
Pyrene Mfg. Co., Newark, N. J.

FIRE HOSE. (See Hose, Fire)

FIREPROOF BUILDING MATERIAL

*Truscon Steel Co., Youngstown, O.
Berger Mfg. Co., Canton, O.
Corrugated Bar Co., Inc., Buffalo, N. Y.
Delaware Clay Products Co., Pittsburgh, Pa.
Detroit Steel Prod. Co., Detroit, Mich.
General Fireproofing Co., Youngstown, O.
Kessler & Mattison Co., Ambler, Pa.
Kinnear Mfg. Co., Columbus, O.
National Fireproofing Co., Pittsburgh, Pa.
United States Gypsum Co., Chicago, Ill.
Youngstown Pressed Steel, Co., Warren, O.

FIRST AID EQUIPMENT

American-La France Fire Eng. Co., Elmira, N. Y.

FLEXIBLE JOINTS

*Central Foundry Co., New York.
*U. S. C. I. Pipe & Fdry Co., Burlington, N. J.
Coldwell-Wilcox Co., Newburgh, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
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*Barber Asphalt Co., Philadelphia, Pa.
Am. Mason Safety Tread Co., Lowell, Mass.
Barrett Co., New York.
Johns-Manville Co., H. W., New York.
Marine Decking & Supply Co., Phila., Pa.
Muller, Franklyn R., & Co., Waukegan, Ill.

FLOORS, WOOD BLOCK
Barrett Co., New York.
Carter Bloxonend Flooring Co., Kansas City, Mo.
Jennison-Wright Co., Toledo, O.
Midland Creosoting Co., Toledo, O.
Republic Creosoting Co., Indianapolis, Ind.
Servicised Products Co., Chicago, Ill.
Sou. Wood Preserving Co., Atlanta, Ga.
Wyckoff Pipe & Creosoting Co., New York.

FLUSH TANKS
Pacific Flush Tank Co., Chicago, Ill.

FLUSHERS, STREET. **(See Street Flushers and Sprinklers.)**

FORGES
Buffalo Forge Co., Buffalo, N. Y.
Hauck Mfg. Co., Brooklyn, N. Y.

FORM CLAMPS
*Insley Mfg. Co., Indianapolis, Ind.
Marion Malleable Iron Works, Marion, Ind.
Universal Form Clamp Co., Chicago, Ill.

FORMS, CONCRETE
*Blaw-Knox Co., Pittsburgh, Pa.
*Connery & Co., Philadelphia, Pa.
*Truscon Steel Co., Youngstown, O.
Concrete Form Co., Inc., Syracuse, N. Y.
Hetzel Steel Form & Iron Co., The, Warren, O.
Lakewood Eng. Co., Cleveland, Ohio.
Metal Forms Corp., Milwaukee, Wis.

FOUNTAINS, DRINKING
Casey-Hedges Co., Chattanooga, Tenn.
Clow & Sons, Jas. B., Chicago, Ill.
Crane Co., Chicago, Ill.
Mott Iron Wks., J. L., New York.
Murdock Mfg. & Supply Co., Cincinnati, Ohio.
Puro San. Dr. Ftn. Co., Haydenville, Mass.
Rundle-Spence Mfg. Co., Milwaukee, Wis.
Stewart Iron Works Co., Cincinnati, O.
Taylor Co., Halsey W., Warren, O.
Twentieth Century Brass Wks., Belleville, Ill.

FURNITURE AND FILES, STEEL
Art Metal Constn. Co., Jamestown, N. Y.
General Fireproofing Co., Youngstown, O.
Van Dorn Iron Works Co., Cleveland, O.

GARBAGE CANS. **(See Cans)**

GARBAGE DISPOSAL
Balmer Corp., New York.
Bartlett, C. O. & Snow Co., Cleveland, O.
Decarie Incinerator Co., Minneapolis, Minn.
Jones & Very, New York
Morse-Boulger Destructor Co., New York.
Nye Odorless Crematory Co., Macon, Ga.

GARBAGE TRUCKS AND BODIES
*Heil Co., Milwaukee, Wis.
Convertible Wagon-Trailers, Inc., Buffalo, N. Y.
Holsbog & Bro., Geo. H., Jeffersonville, Ind.
Lee Trailer & Body Co., Chicago, Ill.
Tiffin Wagon Co., Tiffin, O.
Watson Products Corp., Canastota, N. Y.

GAS ENGINES. **(See Engines, Gas and Gasoline.)**

GAS METERS. **(See Meters, Gas)**

GAS PRODUCERS
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.
Wood & Co., R. D., Florence, N. J.

GASOLINE STORAGE TANKS
*Heil Co., Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
Biggs Boiler Works, Akron, Ohio.
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Byers Machine Co., Ravenna, Ohio.
Chicago Bridge & Iron Works, Chicago, Ill.
Scaife & Sons, Wm. B., Oakmont, Pa.
United Iron Works, Kansas City, Mo.
Wayne Tank & Pump Co., Ft. Wayne, Ind.

GATES, SLUICE
*Ludlow Valve Mfg. Co., Troy, N. Y.
Chapman Valve Mfg. Co., Indian Orchard, Mass
Coffin Valve Co., Boston, Mass.
Coldwell-Wilcox Co., Newburgh, N. Y.
Hardesty Mfg. Co., The, Denver, Col.

GAUGES, RECORDING, PRESSURE, STEAM
Ashcroft Mfg. Co., Bridgeport, Conn.
Bristol Co., Waterbury, Conn.
Cresby Steam Gauge & Valve Co., Boston, Mass
Marsh & Co., Jas. P., Chicago, Ill.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y.
U. S. Gauge Co., New York

GAUGES, WATER
Bristol Co., Waterbury, Conn.
Lunkenheimer Co., Cincinnati, O.
United States Gauge Co., New York.
Walworth Mfg. Co., Boston, Mass.

GAUGES, SURFACE, RESERVOIR AND SPECIAL WATER-WORKS
*Clark Co., H. W., Mattoon, Ill.
Builders Iron Foundry, Providence, R. I.
Simplex Valve & Meter Co., Philadelphia, Pa.

GLASS, FIREPROOF. **(See Wire Glass.)**

GRADERS, ROAD **(See "Road Graders")**

GRADER BLADES
*Adams & Co., J. D., Indianapolis, Ind.
*Shunk Mfg. Co., Bucyrus, Ohio.

GRAND STANDS, PORTABLE
Leavitt Mfg. Co., Urbana, Ill.
Wayne Iron Wks., Philadelphia, Pa.

GRINDERS AND SAND RAMMERS
Chicago Pneumatic Tool Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, Ohio.
Ingersoll-Rand Co., New York, N. Y.

GYPSUM PRODUCTS
U. S. Gypsum Co., Chicago, Ill.

HAMMER DRILLS
(See Drills, Hammer.)

HAMMERS, STEAM, PILE. **(See Pile Hammers, Steam)**

HEAT INSULATING MATERIAL
*Carey Co., Philip, Cincinnati, Ohio.
Johns-Manville, Inc., New York.

HEATERS AND DISTRIBUTORS, TAR AND ASPHALT HEATING KETTLES
*Kinney Mfg. Co., Boston, Mass.

HEATING KETTLES. **(See Kettles)**

HOISTS, BELT-DRIVEN
*Pawling & Harnischfeger Co., Milwaukee, Wis.
*Street Bros. Mach. Wks., Chattanooga, Tenn.
American Hoist & Derrick Co., St. Paul, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Lidgerwood Mfg. Co., New York.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Mundy Hoisting Engine Co., J. S., Newark, N. J.
Weller Mfg. Co., Chicago, Ill.

HOISTS, CONCRETE, TOWER
*Insley Mfg. Co., Indianapolis, Ind.
*Ransome Concrete Mchy. Co., Dunellen, N. J.
Lakewood Engineering Co., Cleveland, O.
Mead-Morrison Mfg. Co., E. Boston, Mass.

HOISTS, ELECTRIC

*Pawling & Harnischfeger Co., Milwaukee, Wis.
*Street Bros. Mach. Wks., Chattanooga, Tenn.
American Hoist & Derrick Co., St. Paul, Minn.
C. H. & E. Mfg. Co., Milwaukee, Wis.
Clyde Iron Works Sales Co., Duluth, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Flory Mfg. Co., S., Bangor, Pa.
Lidgerwood Mfg. Co., New York.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Mundy Hoisting Eng. Co., J. S., Newark, N. J.
National Hoisting Engine Co., Harrison, N. J.
Treadwell Eng. Co., Easton, Pa.

HOISTS, GASOLINE

*American Cement Mchy. Co., Inc., Keokuk, Ia.
*Domestic Engine & Pump Co., Shippensburg, Pa.
*Pawling & Harnischfeger Co., Milwaukee, Wis.
*Street Bros. Mach. Wks., Chattanooga, Tenn.
C. H. & E. Mfg. Co., Milwaukee, Wis.
Austin Machinery Corp'n, Toledo, O.
Buffalo Hoist & Derrick Co., Buffalo, N. Y.
Clyde Iron Works Sales Co., Duluth, Minn.
Construction Machy. Co., Waterloo, Iowa.
Flory Mfg. Co., S., Bangor, Pa.
Lansing Co., Lansing, Mich.
Lidgerwood Mfg. Co., New York.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Monighan Machine Co., Chicago, Ill.
Mundy Hoisting Engine Co., J. S., Newark, N. J.
National Hoisting Engine Co., Harrison, N. J.
Novo Engine Co., Lansing, Mich.
O. K. Clutch & Mach. Co., Columbia, Pa.
Orr & Sembower, Reading, Pa.
Schramm, Inc., West Chester, Pa.

HOISTS, PNEUMATIC

*Denver Rock Drill Mfg. Co., Denver, Colo.
Chicago Pneumatic Tool Co., New York.
Detroit Hoist & Machine Co., Detroit, Mich.
Hanna Eng. Works, Chicago, Ill.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Northern Engineering Works, Detroit, Mich.
Sullivan Mach'y Co., Chicago, Ill.
Worthington Pump & Mchy. Corp., New York.

HOISTS, STEAM

*Denver Rock Drill Mfg. Co., Denver, Colo.
*Insley Mfg. Co., Indianapolis, Ind.
American Hoist & Derrick Co., St. Paul, Minn.
Austin Machinery Corp'n, Toledo, O.
Byers Machine Co., Ravenna, Ohio.
Clyde Iron Works Sales Co., Duluth, Minn.
Flory Mfg. Co., S., Bangor, Pa.
Hardie-Tynes Mfg. Co., Birmingham, Ala.
Ingersoll-Rand Co., New York.
Lidgerwood Mfg. Co., New York.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Mundy Hoisting Eng. Co., J. S., Newark, N. J.
National Hoisting Engine Co., Harrison, N. J.
Orr & Sembower, Reading, Pa.
Treadwell Eng. Co., Easton, Pa.

HOISTS FOR MOTOR TRUCKS

*Hall Co., The Milwaukee, Wis.
*Rock Mfg. Co., Waterloo, N. Y.
*Wood Hydr. Hoist & Body Co., Detroit, Mich.
(Horizontal Hydr. Hoist Co., Detroit, Mich.)
Perfection Hoist & Engine Co., Two Rivers, Wis.
Van Dorn Iron Wks., Cleveland, O.

HOLLOW TILE

Bannon Pipe Co., P., Louisville, Ky.
Dee Co., Wm. E., Chicago, Ill.
Delaware Clay Products Co., Pittsburgh, Pa.
Dickey Clay Mfg. Co., W. S., Kansas City, Mo.
Medal Paving Brick Co., Cleveland, Ohio.
Metropolitan Paving Brick Co., Canton, Ohio.
National Fireproofing Co., Pittsburgh, Pa.

HOPPERS, CONCRETE

*Insley Mfg. Co., Indianapolis, Ind.
*Littleford Bros., Cincinnati, O.
*Ransome Concrete Mchy. Co., Dunellen, N. J.
Lakewood Engineering Co., Cleveland, O.
Weller Mfg. Co., Chicago, Ill.

HOSE, AIR

Chicago Pneumatic Tool Co., New York
Cincinnati Rubber Mfg. Co., Cincinnati, O.
Goodyear Tire & Rubber Co., Akron, O.
Ingersoll-Rand Co., New York.
Penna Flexible Metallic Tubing Co., Phila., Pa.
Republic Rubber Co., Youngstown, O.
U. S. Rubber Co., New York

HOSE, FIRE

*Goodrich Rubber Co., B. F., Akron, O.
Bi-Lateral Fire Hose Co., Chicago, Ill.
Fabric Fire Hose Co., New York.
Goodyear Tire & Rubber Co., Akron, Ohio.
U. S. Rubber Co., New York.

HOUSE NUMBERS

Hamilton Metal Prod. Co., Hamilton, O.
Niagara Metal Stamping Corp., Nia. Falls, N. Y.

HOUSES, PORTABLE. (See Buildings, Portable)

HYDRANTS, FIRE

*Ludlow Valve Mfg. Co., Troy, N. Y.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Columbian Iron Works, Chattanooga, Tenn.
Darling Valve & Mfg. Co., Williamsport, Pa.
Eddy Valve Mfg. Co., Waterford, N. Y.
Iowa Valve Co., Oskaloosa, Ia.
Kennedy Valve Mfg. Co., Elmira, N. Y.
Norwood Engineering Co., Florence, Mass.
Rensselaer Valve Co., Troy, N. Y.
Smith Mfg. Co., A. P., East Orange, N. J.
Wood & Co., R. D., Philadelphia, Pa.

HYDRAULIC RAMS

Deming Co., Salem, O.
Rice Hydraulic Engine Co., New York
Seattle Machine Works, Seattle, Wash.

ICE-MAKING MACHINERY

Brunswick-Kroeschell Co., New Brunswick, N. J.
Carbondale Machine Co., Carbondale, Pa.
Frick Co., Inc., Waynesboro, Pa.
Triumph Ice Machine Co., Cincinnati, O.
United Iron Wks., Kansas City, Mo.
Vilter Mfg. Co., Milwaukee, Wis.
Vogt Mach. Co., Henry, Louisville, Ky.
York Mfg. Co., York, Pa.

INCINERATORS, GARBAGE. (See Garbage Disposal)

INDICATOR POSTS. (See Valves)

INSPECTING LABORATORIES

*Conard & Busby, Burlington, N. J.
*Standard Testing Laboratories, Inc., New York
Allentown Testing Laboratories, Allentown, Pa.
Conwell & Co., E. L., Philadelphia, Pa.
Gulick-Henderson Co., New York
Hunt & Co., Robert W., Chicago, Ill.
N. Y. Testing Laboratories, New York.
Pittsburgh Testing Laboratories, Pittsburgh, Pa.

INSTRUMENTS AND SUPPLIES. (Surveyors' and Engineers')

Ainsworth & Sons, Wm., Denver, Col.
Beckman Co., L., Toledo, Ohio
Berger & Sons, C. L., Boston, Mass.
Brandis & Sons Mfg. Co., Brooklyn, N. Y.
Buff & Buff Mfg. Co., Boston, Mass.
Dietzgen Co., Eugene, Chicago, Ill.
Gurley, W. & L. E., Troy, N. Y.
Keuffel & Esser Co., Hoboken, N. J.
Kolesch & Co., New York.
Lietz Co., A., San Francisco, Cal.
Leupold & Voelpel, Portland, Ore.
Pfister, Wm. H., Cincinnati, O.
Ulmer, J. C., Co., Cleveland, Ohio.
Weber & Co., F., Philadelphia, Pa.
White Co., David, Milwaukee, Wis.
Wissler Instrument Co., St. Louis, Mo.

IRON WORK, STRUCTURAL AND ORNAMENTAL (See Bridges and Buildings)

JACKS, LIFTING

*McKiernan-Terry Drill Co., New York.
Buda Company, Chicago, Ill.
Duff Mfg. Co., Pittsburgh, Pa.
Joyce-Cridland Co., Dayton, O.
Kalamazoo Railway Supply Co., Kalamazoo, Mich
Norton, Inc., A. O., Boston, Mass.
Rees Mfg. Co., Pittsburgh, Pa.
Templeton, Kenly & Co., Ltd., Chicago, Ill.
Watson-Stillman Company, New York.

JACKS, PIPE FORCING
*Clark Co., H. W., Matteson, Ill.
Duff Mfg. Co., Pittsburgh, Pa.

JAIL AND PRISON WORK
Barnum Iron Works, E. T., Detroit, Mich.
Pauly Jail Bldg. Co., St. Louis, Mo.
Stewart Iron Works Co., Cincinnati, Ohio.
Van Dorn Iron Works Co., Cleveland, O.

JOINTS, EXPANSION PAVING
(See Expansion Joint Material)

JOINTS, FLEXIBLE PIPE. (See Flexible Joints.)

KETTLES, FOR ASPHALT AND TAR HEATING
*Barber Asphalt Co., Philadelphia, Pa.
*Connery & Co., Inc., Philadelphia, Pa.
*Good Roads Machinery Co., Kennett Square, Pa.
*Kinney Mfg. Co., Boston, Mass.
*Littleford Bros., Cincinnati, O.
*Universal Road Machinery Co., Kingston, N. Y.
Acme Road Mach. Co., Frankfort, N. Y.
Hauck Mfg. Co., Brooklyn, N. Y.
Honhorst Co., Jos., Cincinnati, Ohio.
Macleod Co., Cincinnati, O.
Stuebner Iron Wks., G. L., L. I. City, N. Y.
Tarrant Mfg. Co., Saratoga Springs, N. Y.
Union Iron Wks., Hoboken, N. J.

LANTERNS, CONTRACTORS'
Adams & Westlake Co., Chicago, Ill.
Defiance Lantern & Stamping Co., Rochester, N.Y.
Dietz Co., R. E., New York.
Handlan, Buck Mfg. Co., St. Louis, Mo.

LATH, METAL
*Truscon Steel Co., Youngstown, O.
Berger Mfg. Co., Canton, O.
Bostwick Steel Lath Co., Niles, O.
Corrugated Bar Co., Inc., Buffalo, N. Y.
General Fireproofing Co., Youngstown, O.
Milwaukee Corrugating Co., Milwaukee, Wis.
Northwestern Expanded Metal Co., Chicago, Ill.
Penn Metal Co., Boston, Mass.
Sykes Metal Lath & Roofing Co., Niles, O.
Youngstown Pressed Steel Co., Warren, O.

LAWN MOWERS
Chadborn & Coldwell Mfg. Co., Newburgh, N. Y.
Coldwell Lawn Mower Co., Newburgh, N. Y.
Gilson Mfg. Co., Port Washington, Wis.
Ideal Power Lawn Mower Co., Lansing, Mich.
Jacobsen Mfg. Co., Racine, Wis.
Penna. Lawn Mower Works, Philadelphia, Pa.
Philadelphia Lawn Mower Co., Philadelphia, Pa.
Townsend Co., S. P., Bloomfield, N. J.
Worthington Mower Co., Shawnee, Pa.

LEADITE
Leadite Co., The, Philadelphia, Pa.
*Littleford Bros., Cincinnati, O.
Canton Fdry & Machy. Co., Canton, O.
Chicago Flexible Shaft Co., Chicago, Ill.
Focht's Sons, Geo., Hoboken, N. J.
Hauck Mfg. Co., Brooklyn, N. Y.
Smith Mfg. Co., A. P., E. Orange, N. J.

LEAD-MELTING FURNACES

LETTERS AND FIGURES, METAL
Niagara Metal Stamp. Corp., Niagara Falls, N. Y.

LIGHTS, CONTRACTORS
Carbic Mfg. Co., Duluth, Minn.
General Electric Co., Schenectady, N. Y.
Hauck Mfg. Co., Brooklyn, N. Y.
Macleod Co., Cincinnati, O.
Milburn Co., Alex., Baltimore, Md.
Prest-O-Lite Co., Inc., New York

LIGHTING STANDARDS. (See Street Lamp Posts)

LIQUID CHLORINE
Electro Bleaching Gas Co., New York.
Mathieson Alkali Works, Inc., New York.
Penna. Salt Mfg. Co., Philadelphia, Pa.

LOADERS, GRAVEL, WAGON, CAR, ETC.
*Atlas Engineering Co., Milwaukee, Wis.
*Kalss Mfg. Co., Geo., New York.
*Sauerman Bros., Chicago, Ill.
*Universal Road Machinery Co., Kingston, N. Y.
Austin Machinery Corp'n, Toledo, O.
Bacon Co., Edw. R., San Francisco, Cal.
Barber-Greene Co., Aurora, Ill.
Bay City Dredge Works, Bay City, Mich.
Bonney Supply Co., Inc., Rochester, N. Y.
Chain Belt Co., Milwaukee, Wis.
Conant Machine Co., Concord Jct., Mass.
Economy Excavator Co., Iowa Falls, Iowa.
Fairfield Engineering Co., Lancaster, Ohio.
Gifford-Wood Co., Hudson, N. Y.
Jeffrey Mfg. Co., Columbus, O.
Lee Trailer & Body Co., Chicago, Ill.
Link-Belt Co., Chicago, Ill.
Lyle Cultv. & Rd. Equip. Co., Minneapolis, Minn.
Nelson Iron Wks., Brooklyn, N. Y.
Portable Machy. Co., Passaic, N. J.
Sackett Screen & Chute Co., H. B., Chicago, Ill
Smith Co., T. L., Milwaukee, Wis.
Weller Mfg. Co., Chicago, Ill.

LOCK BAR STEEL PIPE
East Jersey Pipe Co., New York.

LOCKERS, STEEL
Durand Steel Locker Co., Chicago, Ill.
Hart & Hutchinson Co., New Britain, Conn.
Lyon Metallic Mfg. Co., Aurora, Ill.
Medart Mfg. Co., Fred., St. Louis, Mo.

LOCOMOTIVES, FOR CONTRACTORS, ETC.
*Porter Co., H. K., Pittsburgh, Pa.
American Locomotive Co., New York, N. Y.
Baldwin Locomotive Works, The, Phila., Pa.
Brookville Track & Tractor Co., Brookville, Pa.
Davenport Locomotive Works, Davenport, Ia.
Fate-Root-Heath Co., Plymouth, O.
Lima Locomotive Wks., Lima, O.
Industrial Equipment Co., Inc., Minster, O.
Milwaukee Locomotive Mfg. Co., Milwaukee, Wis.
Vulcan Iron Works, Wilkes-Barre, Pa.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa
Whitcomb Co., Geo. D., Rochelle, Ill.

LUMBER, HEAVY CONSTRUCTION
Brown Co., Portland, Me.
Crowell & Spencer Lumber Co., Long Leaf, La.
Exchange Sawmills Sales Co., Kansas City, Mo.
Great Southern Lumber Co., Bogalusa, La.
Industrial Lumber Co., Elizabeth, La.
Long Bell Lumber Co., Kansas City, Mo.
Sargent Lumber Co., Little Rock, Ark.
Sterner Co., Inc., E. J., New York
Weyerhaeuser Sales Co., Spokane, Wash.

LUMBER, STEEL
*Truscon Steel Co., Detroit, Mich.
Berger Mfg. Co., Canton, O.
General Fireproofing Co., Youngstown, O.
National Pressed Steel Co., Massillon, O.

MANHOLE COVERS. (See "Castings, Street")

METAL LATH. (See "Lath")

METAL ROOFING (See "Roofing)

METER BOXES
*Clark Co., H. W., Matteson, Ill.
*Ford Meter Box Co., Wabash, Ind.
Clow & Sons, J. B., Chicago, Ill.
Columbian Iron Works, Chattanooga, Tenn.
Mueller Mfg. Co., H., Decatur, Ill.

METER COUPLINGS
*Clark Co., H. W., Matteson, Ill.
*Ford Meter Box Co., Wabash, Ind.
*Neptune Meter Co., New York.
*Pittsburgh Meter Co., E. Pittsburgh, Pa.
*Union Water Meter Co., Worcester, Mass.
Mueller Mfg. Co., H., Decatur, Ill.

METER TESTERS
*Clark Co., H. W., Matteson, Ill.
*Ford Meter Box Co., Wabash, Ind.
*Neptune Meter Co., New York.
*Pittsburgh Meter Co., E. Pittsburgh, Pa.

Buffalo Meter Co., Buffalo, N. Y.
Mueller Mfg. Co., H., Decatur, Ill.
National Meter Co., New York.

METERS, ELECTRIC (WATTHOUR)

Duncan Elec. Mfg. Co., LaFayette, Ind.
General Electric Co., Schenectady, N. Y.
Sangamo Electric Co., Springfield, Ill.
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

METERS, GAS

*Pittsburgh Meter Co., E. Pittsburgh, Pa.
American Meter Co., New York
Bailey Meter Co., Cleveland, O.
Builders Iron Fdry., Providence, R. I.
Cleveland Gas Meter Co., Cleveland, O.

METERS, WATER

*Badger Meter Mfg. Co., Milwaukee, Wis.
*Neptune Meter Co., New York.
*Pittsburgh Meter Co., E. Pittsburgh, Pa.
*Union Water Meter Co., Worcester, Mass.
Buffalo Meter Co., Buffalo, N. Y.
Federal Meter Co., Brooklyn, N. Y.
Gamon Meter Co., Newark, N. J.
Hersey Mfg. Co., Boston, Mass.
National Meter Co., New York.
Thomson Meter Co., Brooklyn, N. Y.
Worthington Pump & Mchy. Corp., New York.

METERS, WATER (VENTURI TYPE)

Builders Iron Foundry, Providence, R. I.
Simplex Valve & Meter Co., Philadelphia, Pa.

MIXERS, CONCRETE. (See Concrete Mixers.)

MIXERS, GROUT

*American Cement Mchy. Co., Inc., Keokuk, Ia.
Kent Machine Co., Kent, O.
Lakewood Engineering Co., Cleveland, O.
Union Iron Works, Inc., Hoboken, N. J.

MIXERS, HOT

*Barber Asphalt Co., Philadelphia, Pa.
*Koehring Co., Milwaukee, Wis.
Austin Machinery Corp'n, Toledo, O.
Kent Machine Co., Kent, O.

MIXERS, MORTAR

*American Cement Mchy. Co., Inc., Keokuk, Ia.
*Blaw-Knox Co., Pittsburgh, Pa.
*Ransome Concrete Mchy. Co., Dunellen, N. J.
Austin Machinery Corp'n, Toledo, O.
C. H. & E. Mfg. Co., Milwaukee, Wis.
Construction Machinery Co., Waterloo, Ia.
Kent Machine Co., Kent, O.
Knickerbocker Co., Jackson, Mich.
Lansing Co., Lansing, Mich.
Lakewood Engineering Co., Cleveland, Ohio.
Marsh-Capron Co., Chicago, Ill.
Smith Co., T. L., Milwaukee, Wis.

MOTORCYCLES

Ace Motor Corp., Philadelphia, Pa.
Cleveland Motorcycle Co., Cleveland, Ohio.
Excelsior Motor Mfg. & Supply Co., Chicago, Ill.
Harley-Davidson Motor Co., Milwaukee, Wis.
Indian Motocycle Co., Springfield, Mass.

MOTORS, ELECTRIC

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Crocker-Wheeler Co., Ampere, N. J.
Cutler-Hammer Mfg. Co., Milwaukee, Wis.
Fairbanks, Morse & Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Holtzer-Cabot Elec. Co., Boston, Mass.
Lincoln Elec. Co., Cleveland, O.
Robbins & Myers Co., Springfield, O.
Wagner Elec. Mfg. Co., St. Louis, Mo.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

MOTORS, GASOLINE

Buda Co., Harvey, Ill.
Continental Motors Corp., Detroit, Mich.
Herschell-Spillman Co., No. Tonawanda, N. Y.
Hinkley Motors, Inc., Detroit, Mich.
Waukesha Motor Co., Waukesha, Wis.
Wisconsin Motor Mfg. Co., Milwaukee, Wis.

MOTOR TRUCKS

*Ford Motor Co., Detroit, Mich.
*Garford Motor Truck Co., Lima, O.
*General Motors Truck Co., Pontiac, Mich.
*International Motor Co., New York.
Acme Motor Truck Co., Cadillac, Mich.
Atterbury Motor Car Co., Buffalo, N. Y.
Autocar Co., Ardmore, Pa.
Bessemer Motor Truck Co., Grove City, Pa.
Brockway Motor Truck Co., Cortland, N. Y.
Clydesdale Motor Truck Co., Clyde, O.
Corbitt Motor Truck Co., Henderson, No. Car.
Denby Motor Truck Co., Detroit, Mich
Diamond T. Motor Car Co., Chicago, Ill.
Duplex Truck Co., Lansing, Mich.
Federal Motor Truck Co., Detroit, Mich.
Four Wheel Drive Auto Co., Clintonville, Wis.
Gramm Bernstein Motor Truck Co., Lima, O.
Indiana Truck Corp'n., Marion, Ind.
International Harvester Co., Chicago, Ill.
Kelly Springfield Motor Truck Co., Springfield, O.
Kissel Motor Car Co., Hartford, Wis.
Larrabee-Deyo Motor Tr. Co., Binghamton, N.Y.
Nash Motors Co., Kenosha, Wis.
Pierce Arrow Motor Car Co., Buffalo, N. Y.
Republic Motor Truck Co., Alma, Mich.
Rowe Motor Mfg. Co., Lancaster, Pa.
Service Motor Truck Co., Wabash, Ind.
Sterling Motor Truck Co., Milwaukee, Wis.
Stewart Motor Corp'n., Buffalo, N. Y.
Tiffin Wagon Co., Tiffin, O.
Titan Motor Truck Co., Milwaukee, Wis.
Traffic Motor Truck Co., St. Louis, Mo.
Transport Truck Co., Mt. Pleasant, Mich.
U. S. Motor Truck Co., Cincinnati, O.
Ward LaFrance Truck Co., Elmira, N. Y.
Wilson Co., J. C., Detroit, Mich.
White Co., Cleveland, Ohio.

MOULDS, CONCRETE

*Blaw-Knox Co., Pittsburgh, Pa.

NUMBERS, HOUSE (See "House Numbers")

OAKUM

Wall Rope Works, Beverly, N J.

OILS, ROAD

*Barber Asphalt Co., Philadelphia, Pa.
*Pioneer Asphalt Co., Lawrenceville, Ill.
*Standard Oil Co. (Indiana), Chicago, Ill.
*Texas Company, New York.
Atlantic Refining & Asphalt Corp'n, Philadelphia
Barrett Co., New York.
Headley Good Roads Co., Philadelphia, Pa
Pierce Oil Corp., New York.
Sinclair Refining Co., Chicago, Ill.
Standard Oil Co., (La.) New Orleans, La.
Standard Oil Co., (N. J.) Newark, N. J.
Standard Oil Co. (N. Y.), New York.
U. S. Asphalt Refining Co., New York.

OXY-ACETYLENE APPARATUS

Oxweld Acetylene Co., Newark, N. J.

OXYGEN

Linde Air Products Co., New York.

PACKING, WATER PIPE

*Union Water Meter Co., Worcester, Mass.
Leadite Co., The, Philadelphia, Pa.
United Lead Company, New York.

PAINT GUNS

Spray Eng. Co., Boston, Mass.

PAINTS, METAL PROTECTION

*Barber Asphalt Co., Philadelphia, Pa.
*Dixon Crucible Co., Jos., Jersey City, N. J.
*Semet-Solvay Co., Syracuse, N. Y.
*Truscon Laboratories, Detroit, Mich.
Acme White Ld. & Col. Works, Detroit, Mich.
Barrett Co., New York.
Berry Bros., Detroit, Mich.
Carey Co., Philip, Cincinnati, Ohio.
Cook Paint & Varnish Co., Kansas City, Mo.
Detroit Graphite Co., Detroit, Mich.
Detroit White Lead Wks., Detroit, Mich.
Du Pont de Nemours & Co., Inc., E. I., Wilmington, Del.
Minwax Co., New York.

Protexol Corpn., New York.
Ruberoid Co., New York.
Sherwin-Williams Co., Cleveland, O.
Sonneborn Sons, Inc., L., New York.
Toch Bros., New York.
Tropical Paint & Oil Co., Cleveland, Ohio.
Truscon Laboratories, Detroit, Mich.

PAPERS, BLUE PRINT AND BROWN PRINT
Indianapolis Blue Print & Supply Co., Indianapolis, Ind.

PAPER, BUILDING, ROOFING, ETC.
*Barber Asphalt Co., Philadelphia, Pa.
*Carey Co., Philip, Cincinnati, Ohio.
Barrett Co., New York.
Bird & Son, Inc., E. Walpole, Mass.
Brown Co., Portland, Me.
Hydrex Asphalt Products Corp., New York.
Johns-Manville, Inc., New York.
National Roofing Co., Tonawanda, N. Y.
Ruberoid Co., New York.

PARK BENCHES
Art Concrete Works, Pasadena, Calif.
Bausman Mfg. Co., Millersville, Pa.
Dow Co., Louisville, Ky.
Mott Iron Wks., J. L., New York.
Stewart Iron Works, Cincinnati, Ohio.

PAVING AND ROAD ROLLERS (See Road and Paving Rollers)

PAVING BLOCKS, CREOSOTED WOOD
American Creosote Wks., Inc., New Orleans, La.
Carter Bloxonend Flooring Co., Kansas City, Mo.
Compressed Wood Preserving Co., Cincinnati, O.
Creosoted Materials Co., New Orleans, La.
Jennison-Wright Co., Toledo, O.
Republic Creosoting Co., Indianapolis, Ind.
Wyckoff Pipe & Creosoting Co., New York.

PAVING BRICK
Albion Shale Brick Co., Albion, Ill.
Alton Brick Co., Alton, Ill.
Barr Clay Co., Streator, Ill.
Binghamton Brick Co., Binghamton, N. Y.
Burton Townsend Co., Zanesville, O.
Cleveland Brick & Clay Co., Cleveland, O.
Clydesdale Brick & Stone Co., Pittsburgh, Pa.
Coffeyville Vit. Brick & Tile Co., Coffeyville, Kans.
Corry Brick & Tile Co., Corry, Pa.
Flint Brick Co., Des Moines, Ia.
Francis Vit. Brick Co., Boynton, Okla.
Georgia Brick & Tile Co., Adairsville, Ga.
Hammond Fire Brick Co., Fairmont, W. Va.
Hocking Valley Brick Co., Columbus, O.
Hydraulic Press Brick Co., St. Louis, Mo.
Independence Pav. Br. Co., Independence, Kans.
McAvoy Vit. Brick Co., Philadelphia, Pa.
Mack Mfg. Co., Wheeling, W. Va.
Mayer Brick Co., C. P., Bridgeville, Pa.
Medal Paving Brick Co., Cleveland, O.
Metropolitan Paving Brick Co., Canton, O.
Mineral Wells Pav. Brick Co., Mineral Wells, Tx.
Moberly Paving Brick Co., Moberly, Mo.
Murphysboro Paving Brick Co., Murphysboro, Ill.
Patton Clay Mfg. Co., Patton, Pa.
Peebles Brick Co., Portsmouth, O.
Penna. Clay Co., Pittsburgh, Pa.
Pittsburgh Paving Brick Co., Pittsburgh, Kas.
Poston Paving Brick Co., Crawfordsville, Ind.
Purington Paving Brick Co., Galesburg, Ill.
Southern Clay Mfg. Co., Chattanooga, Tenn.
Springfield Paving Brick Co., Springfield, Ill.
Sterling Brick Co., Olean, N. Y.
Streator Clay Mfg. Co., Streator, Ill.
Thornton Fire Brick Co., Clarksburg, W. Va.
Thurber Brick Co., Thurber, Texas.
Toronto Fire Clay Co., Toronto, Ohio.
Trinidad Brick & Tile Co., Trinidad, Colo.
Veedersburg Paver Co., Veedersburg, Ind.
Western Clay Mfg. Co., Helena, Mont.
Westport Paving Brick Co., Westport, Md.

PAVING MACHINERY. (See Road and Paving Machinery)

PAVING GUARDS, STEEL
*Godwin Co., W. S., Baltimore, Md.
International Steel Tie Co., Cleveand, O.

PAVING MATERIALS (See "Asphalt," "Paving Brick," "Granite Block," etc.)

PAVING MIXERS. (See Concrete Mixers)

PAVING TOOLS
*Barber Asphalt Co., Philadelphia, Pa.
*Connery & Co., Inc., Philadelphia, Pa.
*Littlefford Bros. Co., Cincinnati, O.
*Warren Bros. Co., Boston, Mass.
Anderson Tool & Sup. Co., W. H., Detroit, Mich.
Cummer & Sons Co., F. D., Cleveland, O.
Union Iron Works, Hoboken, N. J.

PERFORATED METALS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Hendrick Mfg. Co., Carbondale, Pa.

PICKS
Beall Tool Co., East Alton, Ill.
Hubbard Co., Pittsburgh, Pa.
Iron City Tool Works, Pittsburgh, Pa.
Klein-Logan Co., Pittsburgh, Pa.
Verona Tool Works, Verona, Pa.
Warren Tool & Forge Co., Warren, O.
Warwood Tool Co., Wheeling, W. Va.
Wyoming Shovel Wks., Wyoming, Pa.

PILE DRIVERS
*McKiernan-Terry Drill Co., New York.
Browning Co., Cleveland, O.
Clyde Iron Works Sales Co., Duluth, Minn.
Industrial Works, Bay City, Mich.
Lidgerwood Manufacturing Co., New York.
Mead-Morrison Mfg. Co., E. Boston, Mass.
McMyler Interstate Co., Cleveland, O.
Union Iron Works, Hoboken, N. J.

PILE HAMMERS, STEAM
*McKiernan-Terry Drill Co., New York.
Clyde Iron Works Sales Co., Duluth, Minn.
Industrial Works, Bay City, Mich.
National Hoisting Eng. Co., Harrison, N. J.
Union Iron Works, Hoboken, N. J.
Vulcan Iron Works, Chicago, Ill.

PILING, CONCRETE
MacArthur Concrete Pile & Foundation Co., N.Y.
Raymond Concrete Pile Co., New York.

PILING, INTERLOCKING STEEL
Bethlehem Steel Co., Bethlehem, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Jones & Laughlin Steel Co., Pittsburgh, Pa.

PIPE, CAST IRON
*Central Foundry Co., New York.
*U. S. Cast Iron Pipe & Fdy. Co., Burlington, N.J.
American Cast Iron Pipe Co., Birmingham, Ala.
Clow & Sons, J. B., Chicago, Ill.
Donaldson Iron Co., Emaus, Pa.
Fox & Co., John, New York.
Glamorgan Pipe & Fdry. Co., Lynchburg, Va.
Lynchburg Foundry Co., Lynchburg, Va.
National Cast Iron Pipe Co., Birmingham, Ala.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Warren Fdry. & Machine Co., New York.
Wood & Co., R. D., Philadelphia, Pa.

PIPE, CULVERT (See Culverts)

PIPE, LEAD
United Lead Company, New York

PIPE, REINFORCED CONCRETE
Concrete Products Co., Pittsburgh, Pa.
Core Joint Concrete Pipe Co., Baltimore, Md.
Independent Concrete Pipe Co., Indianapolis Ind.
Lock Joint Pipe Co., E. Orange, N. J.
Massey Concrete Products Corp'n, Chicago, Ill

PIPE, RIVETED STEEL
*Blaw-Knox Co., Pittsburgh, Pa.
*Connery & Co., Inc., Philadelphia, Pa.
*Littlefford Bros. Cincinnati, Ohio.
Abendroth & Root Mfg. Co., Newburgh, N. Y.
American Spiral Pipe Works, Chicago, Ill.
Canton Culvert & Silo Co., Canton, O.
Chatta. Boiler & Tank Co., Chattanooga, Tenn.
Chicago Bridge & Iron Works, Chicago, Ill.
East Jersey Pipe Co., New York.
Hammond Iron Works, Warren, Pa.
Hardesty Mfg. Co., R., Denver, Col.
Honhorst Co., Jos., Cincinnati, Ohio.
Lancaster Iron Works, Lancaster, Pa.
Petroleum Iron Works Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Tippet & Wood, Phillipsburg, N. J.
Welter Mfg. Co., Chicago, Ill.

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PIPE, SPIRAL RIVETED

Abendroth & Root Mfg. Co., Newburgh, N. Y.
American Spiral Pipe Works, Chicago, Ill.

PIPE STEEL

East Jersey Pipe Co., New York.
Jones & Laughlin Steel Co., Pittsburgh, Pa.
National Tube Co., Pittsburgh, Pa.
Republic Iron & Steel Co., Youngstown, O.
Steel & Tube Co. of Am., Chicago, Ill.
Youngstown Sheet & Tube Co., Youngstown, O.

PIPE, WOOD

American Wood Pipe Co., Tacoma, Wash.
Continental Pipe Mfg. Co., Seattle, Wash.
Michigan Pipe Co., Bay City, Mich.
Pacific Tank & Pipe Co., San Francisco, Cal.
Redwood Mfrs. Co., San Francisco, Cal.
Standard Wood Pipe Co., Williamsport, Pa.
Wyckoff & Sons Co., A., Elmira, N. Y.

PIPE, WROUGHT IRON

Byers Co., A. M., Pittsburgh, Pa.
Reading Iron Co., Reading, Pa.

PIPE BENDING MACHINES

Amer. Pipe Bending Mach. Co., Boston, Mass.
Walworth Mfg. Co., Boston, Mass.

PIPE COVERING

AIRCELL

*Carey Co., Philip, Cincinnati, Ohio.
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Johns-Manville, Inc., New York.
Keasbey & Mattison Co., Ambler, Pa.
Nat'l Asbestos Co., Jersey City, N. J.
Norristown Mag. & Asb. Co., Norristown, Pa.
Sall Mt. Co., Chicago, Ill.
Watson Co., H. F., Erie, Pa.

85 PER CENT MAGNESIA

*Carey Co., Philip, Cincinnati, Ohio.
Ehret Magnesia Co., Valley Forge, Pa.
Johns-Manville, Inc., New York.
Keasbey & Mattison Co., Ambler, Pa.

WOOD

Continental Pipe Mfg. Co., Seattle, Wn.
Redwood Mfrs. Co., San Francisco, Cal.
Ric-Wil Co., Cleveland, O.
Wyckoff & Son Co., A., Elmira, N. Y.

PIPE CUTTERS. **(See Cutters, Pipe, Hand.)**

PIPE FITTINGS

*Central Foundry Co., New York.
*U. S. Cast Iron Pipe & Fdry. Co., Burlington, N. J.
American C. I. Pipe Co., Birmingham, Ala.
Builders Iron Fdry, Providence, R. I.
Clow & Sons, J. B., Chicago, Ill.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
Reading Steel Casting Co., Bridgeport, Conn.
Warren Fdry. & Mach. Co., New York.
Wood & Co., R. D., Philadelphia, Pa.

PIPE HANDLING MACHINERY

Mueller Mfg. Co., H., Decatur, Ill.
Taylor Portable Steel Derrick Co., Chicago, Ill.

PIPE JOINT COMPOUND. **(Sewer)**

*Carey Co., Philip, Cincinnati, Ohio.
*Waring-Underwood Co., Philadelphia, Pa.
G. K. Sales Co., Macungie, Pa.
Leadite Company, Inc., Philadelphia, Pa.
Pacific Flush Tank Co., Chicago, Ill.
Ruberoid Co., New York.

PIPE JOINT MATERIAL. **(Cast Iron)**

Lead-Hydro-Tite Co., Boston, Mass.
Leadite Co., The, Philadelphia, Pa.
United Lead Co., New York.

PLAYGROUND APPARATUS

American Playground Device Co., Anderson, Ind
Everwear Mfg. Co., Springfield, O.
Exerswing Co., Minneapolis, Minn.
George, Howard, Philadelphia, Pa.
Hill-Standard Co., Anderson, Ind.
Medart Mfg. Co., Fred., St. Louis, Mo.
Spalding & Bros., A. G., Chicopee, Mass.

PLOWS, CONTRACTORS

*Adams & Co., J. D., Indianapolis, Ind.
*Austin-Western Rd. Mach. Co., Chicago, Ill.
*Burch Plow Works Co., Crestline, O.
*Holt Mfg. Co., Peoria, Ill.
*Russell Grader Mfg. Co., Minneapolis, Minn.
American Steel Scraper Co., Sidney, O.
Avery Co., Peoria, Ill.
Deere & Co., Moline, Ill.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y
International Harvester Co., Chicago, Ill.
Moline Plow Co., Rock Island, Ill.
Oliver Chilled Plow Works, South Bend, Ind.
Sidney Steel Scraper Co., Sidney, O.
Smith & Sons Mfg. Co., Kansas City, Mo.
Western Wheeled Scraper Co., Aurora, Ill.
Wiard Plow Co., Batavia, N. Y.

PLUMBING SUPPLIES

Clow & Sons, J. B., Chicago, Ill.
Crane Co., Chicago, Ill.
Glauber Brass Mfg. Co., Cleveland, O.
Mott Iron Wks., J. L., New York
Mueller Mfg. Co., H., Decatur, Ill.
Randle-Spence Mfg. Co., Milwaukee, Wis.
United Brass Mfg. Co., Cleveland, O.
Walworth Mfg. Co., Boston, Mass.

POLES, STEEL STRUCTURAL

*Blaw-Knox Co., Pittsburgh, Pa.
Electric Railway Equipment Co., Cincinnati, O.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa

PORTABLE BUILDINGS

*Blaw-Knox Co., Pittsburgh, Pa.
*Littleford Bros., Cincinnati, Ohio.
*Truscon Steel Co., Youngstown, O.
Milwaukee Corrugating Co., Milwaukee, Wis.
Pruden Co., C. D., Baltimore, Md.

PORTABLE STEEL DERRICKS. **(See Derricks, Steel Portable.)**

PORTLAND CEMENT. **(See Cement.)**

POWDER. **(See Explosives.)**

PUMPS, AIR LIFT

Harris Air Pump Co., Indianapolis, Ind.
Indiana Air Pump Co., Indianapolis, Ind.
Ingersoll-Rand Co., New York.
Sullivan Machinery Co., Chicago, Ill.

PUMPS, BOILER FEED

Advance Pump & Compr. Co., Battle Creek, Mich.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Steam Pump Co., Battle Creek, Mich.
Aurora Pump & Mfg. Co., Aurora, Ill.
Bethlehem Steel Co., Bethlehem, Pa.
Buffalo Steam Pump Co., Buffalo, N. Y.
Cameron Steam Pump Works, A. S., New York
Dayton-Dowd Co., Quincy, Ill.
Dean Bros. Steam Pump Wks., Indianapolis, Ind.
De Laval Steam Turbine Co., Trenton, N. J.
Deming Co., Salem, O.
Fairbanks, Morse & Co., Chicago, Ill.
Gardner Governor Co., Quincy, Ill.
Goulds Mfg. Co., Seneca Falls, N. Y.
Indiana Air Pump Co., Indianapolis, Ind.
LeCourtenay Co., Newark, N. J.
Midwest Engine Co., Indianapolis, Ind.
Morris Machine Works, Baldwinsville, N. Y.
Murray Iron Works Co., Burlington, Ia.
Northern Fire Apparatus Co., Minneapolis, Minn
Scranton Pump Co., Scranton, Pa.
Union Steam Pump Co., Battle Creek, Mich
Vogt Bros. Mfg. Co., Louisville, Ky.
Warren Steam Pump Co., Warren, Mass.
Weinman Pump Mfg. Co., Columbus, O.
Yeomans Bros. Co., Chicago, Ill.

PUMPS, CENTRIFUGAL

*Domestic Engine & Pump Co., Shippensburg, Pa.
*Keystone Driller Co., Beaver Falls, Pa.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Well Works, Aurora, Ill.
Aurora Pump & Mfg. Co., Aurora, Ill.
Bethlehem Steel Co., Bethlehem, Pa.
Cameron Steam Pump Works, A. S., New York.
Dayton-Dowd Co., Quincy, Ill.
De Laval Steam Turbine Co., Trenton, N. J.
Erie Pump & Engine Works, Medina, N. Y.
Evinrude Motor Co., Milwaukee, Wis.

Fairbanks, Morse & Co., Chicago, Ill.
Goulds Mfg. Co., Seneca Falls, N. Y.
Indiana Air Pump Co., Indianapolis, Ind.
LeCourtenay Co., Newark, N. J.
Manistee Iron Wks., Manistee, Mich.
Midwest Engine Co., Indianapolis, Ind.
Morris Machine Works, Baldwinsville, N. Y.
Schramm, Inc., West Chester, Pa.
United Iron Works, Kansas City, Mo.
Wheeler Condenser & Eng. Co., Carteret, N. J.
Worthington Pump & Mchy. Corp., New York.
Yeomans Bros. Co., Chicago, Ill.

PUMPS, CONTRACTORS'

*Domestic Engine & Pump Co., Shippensburg, Pa.
*Kinney Mfg. Co., Boston, Mass.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Well Works, Aurora, Ill.
Aurora Pump & Mfg. Co., Aurora, Ill.
Barnes Mfg. Co., Mansfield, O.
Buda Co., Harvey, Ill.
Cameron Steam Pump Works, A. S., New York.
Carter Co., Ralph B., New York.
C. H. & E. Mfg. Co., Milwaukee, Wis.
Construction Mach'y Co., Waterloo, Ia.
Dayton-Dowd Co., Quincy, Ill.
Deming Co., Salem, Ohio.
Emerson Pump & Valve Co., Alexandria, Va.
Erie Pump & Engine Works, Medina, N. Y.
Evinrude Motor Co., Milwaukee, Wis.
Fairbanks, Morse & Co., Chicago, Ill.
Goulds Mfg. Co., Seneca Falls, N. Y.
LeCourtenay Co., Newark, N. J.
McGowan Co., J. R., Cincinnati, O.
Midwest Engine Co., Indianapolis, Ind.
Morris Machine Works, Baldwinsville, N. Y.
Myers & Bro. Co., F. E., Ashland, O.
Northern Fire App. Co., Minneapolis, Minn.
Novo Engine Co., Lansing, Mich.
Pulsometer Steam Pump Co., New York.
Schramm, Inc., West Chester, Pa.
Smith Co., T. L., Milwaukee, Wis.
Standard Scale & Supply Co., Pittsburgh, Pa.
Van Nuhuys Machine Wks., Albany, N. Y.
Waldo Bros. & Bend Co., Boston, Mass.

PUMPS, DEEP WELL

*Aldrich Pump Co., Allentown, Pa.
*Clark Co., H. W., Mattoon, Ill.
*Domestic Engine & Pump Co., Shippensburg, Pa.
*Keystone Driller Co., Beaver Falls, Pa.
American Well Works, Aurora, Ill.
Cameron Steam Pump Works, A. S., New York.
Cook, Inc., A. D., Lawrenceburg, Ind.
Deming Co., Salem, O.
Fairbanks, Morse & Co., Chicago, Ill.
Goulds Mfg. Co., Seneca Falls, N. Y.
Harris Air Pump Co., Indianapolis, Ind.
Indiana Air Pump Co., Indianapolis, Ind.
Layne & Bowler Co., Memphis, Tenn.
McDonald Mfg. Co., A. Y., Dubuque, Ia.
Midwest Engine Co., Indianapolis, Ind.
Myers & Bro. Co., F. E., Ashland, O.
United Iron Works, Kansas City, Mo.
Weber Subterranean Pump Co., New York.

PUMPS, DREDGING

*Aldrich Pump Co., Allentown, Pa.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Well Works, Aurora, Ill.
Aurora Pump & Mfg. Co., Aurora, Ill.
Buffalo Steam Pump Co., Buffalo, N. Y.
Cameron Steam Pump Wks., A. S., New York.
Erie Pump & Engine Co., Medina, N. Y.
Morris Machine Works, Baldwinsville, N. Y.
Rumsey Pump Co., Ltd., Seneca Falls, N. Y.
Wood & Co., R. D., Philadelphia, Pa.
Worthington Pump & Mchy. Corp., New York.

PUMPS, GASOLINE AND OIL

*Kinney Mfg. Co., Boston, Mass.
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Buda Co., Harvey, Ill.
Gilbert & Barker Mfg. Co., Springfield, Mass.
Northern Fire App. Co., Minneapolis, Minn.
Wayne Tank & Pump Co., Fort Wayne, Ind.
Worthington Pump & Mach. Corp., New York.

PUMPS, POWER

*Kinney Mfg. Co., Boston, Mass.
*Koehring Co., Milwaukee, Wis.
Alamo Iron Works, San Antonio, Tex.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Steam Pump Co., Battle Creek, Mich.
American Well Works, Aurora, Ill.
Aurora Pump & Mfg. Co., Aurora, Ill.
Barnes Mfg. Co., Mansfield, O.
Dayton-Dowd Co., Quincy, Ill.
De Laval Steam Turbine Co., Trenton, N. J.
Deming Co., Salem, O.
Domestic Engine & Pump Co., Shippensburg, Pa.
Evinrude Motor Co., Milwaukee, Wis.
Fairbanks, Morse & Co., Chicago, Ill.
Gardner Governor Co., Quincy, Ill.
Goulds Mfg. Co., Seneca Falls, N. Y.
Indiana Air Pump Co., Indianapolis, Ind.
Lawrence Machine Co., Lawrence, Mass.
Le-Courtenay Co., Newark, N. J.
McGowan Co., J. H., Cincinnati, O.
Myers & Bro. Co., F. E., Ashland, O.
Nordberg Mfg. Co., Milwaukee, Wis.
Northern Fire Apparatus Co., Minneapolis, Minn.
Weinman Pump Mfg. Co., Columbus, O.
Worthington Pump & Machy. Corp., New York.
Yeomans Bros. Co., Chicago, Ill.

PUMPS, TAR AND ASPHALT

*Kinney Mfg. Co., Boston, Mass.

RAILS AND RAIL JOINTS

*Koppel Ind. Car & Equip. Co., Koppel, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Cambria Steel Co., Philadelphia, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Sweet's Steel Co., Williamsport, Pa.

RAILROAD DITCHERS (See Excavators, Ditch and Trench.)

RECORDERS, WATER STAGE

Builders Iron Fdry., Providence, R. I.
Gurley, W. & L. E., Troy, N. Y.

REFRIGERATING MACHINERY. (See Ice Making Machinery.)

REINFORCING CONCRETE. (See Concrete Reinforcements.)

RIVETERS, PNEUMATIC

Alliance Machine Co., Alliance, O.
Chicago Pneumatic Tool Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Hanna Eng. Works, Chicago, Ill.
Helwig Mfg. Co., St. Paul, Minn.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Watson-Stillman Co., New York.

RIVET SETS

Cleveland Pneumatic Tool Co., Cleveland, O.
Dunbar Drop Forge Co., Chicago, Ill.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.

RIVETS, BRIDGE AND STRUCTURAL. (See Bolts, Nuts, Etc.)

ROAD GRADERS

*Adams & Co., J. D., Indianapolis, Ind.
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Baker Mfg. Co., Springfield, Ill.
*Galion Iron Works & Mfg. Co., Galion, Ohio.
*Good Roads Mach'y Co., Kennett Square, Pa.
*Monroe & Sons, N. S., Arthur, Ill.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Stockland Road Mach. Co., Minneapolis, Minn.
Case Threshing Machine Co., J. I., Racine, Wis.
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
Shaw-Enochs Tractor Co., Minneapolis, Minn.
Smith & Sons Mfg. Co., Kansas City, Mo.

ROAD OILS. (See Oils, Road.)

ROAD OILERS

*Austin-Western Road Mchy. Co., Chicago, Ill.
*Connery & Co., Philadelphia, Pa.
*Good Roads Mach. Co., Kennett Square, Pa.
*International Motor Co., New York.
*Kinney Mfg. Co., Boston, Mass.
*Littleford Bros., Cincinnati, Ohio.
Etnyre & Co., E. D., Oregon, Ill.
White Co., Cleveland, O.

ROAD SCRAPERS
*Adams & Co., J. D., Indianapolis, Ind.
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Baker Mfg. Co., Springfield, Ill.
*East Iron & Machine Co., Lima, Ohio.
*Galion Iron Works & Mfg. Co., Galion, O.
*Good Roads Mach. Co., Kennett Square, Pa.
*Russell Grader Mfg. Co., Minneapolis, Minn.
Acme Road Mach. Co., Frankfort, N. Y.
Avery Co., Peoria, Ill.
Case Threshing Machine Co., J. I., Racine, Wis.
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
Root Spring Scraper Co., Kalamazoo, Mich.
Sidney Steel Scraper Co., Sidney, O.
Smith & Sons Mfg. Co., Kansas City, Mo.
Western Wheeled Scraper Co., Aurora, Ill.

ROAD AND PAVING ROLLERS
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Barber Asphalt Co., Philadelphia, Pa.
*Buffalo Springfield Roller Co., Springfield, O.
*Erie Machine Shops, Erie, Pa.
*Galion Iron Works & Mfg. Co., Galion, Ohio.
*Good Roads Mach. Co., Kennett Square, Pa.
*Huber Mfg. Co., Marion, O.
Avery Co., Peoria, Ill.
Bucyrus Road Machy. Co., Bucyrus, O.
Case Threshing Machine Co., J. I., Racine, Wis.

ROAD AND PAVING MACHINERY
*Adams & Co., J. D., Indianapolis, Ind.
*Atlas Engineering Co., Milwaukee, Wis.
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Baker Mfg. Co., Springfield, Ill.
*Barber Asphalt Co., Philadelphia, Pa.
*Buffalo Springfield Roller Co, Springfield, O.
*Connery & Co., Inc., Philadelphia, Pa.
*East Iron & Mach Co , Lima, Ohio.
*Erie Machine Shops, Erie, Pa.
*Equitable Asph. Maint. Co., Kansas City, Mo.
*Galion Iron Works & Mfg. Co., Galion, Ohio.
*Good Roads Mach. Co., Kennett Square, Pa.
*Haiss Mfg. Co., Geo., New York.
*Holt Mfg. Co., Peoria, Ill.
*International Motor Co., New York
*Kinney Mfg. Co., Boston, Mass.
*Koehring Co., Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
*Monroe & Sons, N. S., Arthur, Ill.
*Ransome Concrete Mchy. Co., Dunellen, N. J.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Stockland Road Mach. Co., Minneapolis, Minn.
*Universal Road Mchy. Co., Kingston, N. Y.
Acme Road Mach. Co., Frankfort, N. Y.
Aultman & Taylor Mach. Co., Mansfield, Ohio.
Austin Machinery Corp'n, Toledo, O.
Avery Co., Peoria, Ill.
Bucyrus Road Machy. Co., Bucyrus, O.
Case Threshing Mach. Co., J. I. Racine, Wis.
Cummer & Son Co., F. D., Cleveland, O.
Edwards Mfg. Co., C. D., Albert Lea, Minn.
Glide Road Mach'y Co., Minneapolis, Minn.
Honhorst Co., Jos., Cincinnati, O.
Lakewood Engineering Co., Cleveland, O.
Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
Smith Co., T. L., Milwaukee, Wis.
Smith & Sons Mfg. Co., Kansas City, Mo.
United Iron Works, Kansas City, Mo.

ROCK CRUSHERS AND PULVERIZERS (See "Crushers")

ROCK DRILLS. (See Drills, Rock)

ROOFING, ASPHALT, COMPOSITION, TILE, ETC.
*Barber Asphalt Co., Philadelphia, Pa.
*Barrett Co., New York
*Carey Co., Philip, Cincinnati, Ohio.
*Standard Oil Co. (Indiana), Chicago, Ill.
*Texas Co., New York.
American Cement Tile Mfg. Co., Pittsburgh, Pa.
Atlantic Refining & Asphalt Corp., Phila., Pa.
Beaver Board Cos., Buffalo, N. Y.
Bird & Son, Inc., E. Walpole, Mass.
Certain-teed Products Corp., New York.
Chatfield Mfg. Co., Cincinnati, Ohio.
Edwards Mfg. Co., Cincinnati, O.
Flintkote Co., Boston, Mass.
Johns-Manville, Inc., New York.
Keystone Roofing Mfg. Co., York, Pa.
Lehon Co., The, Chicago, Ill.
Lewis Mfg. Co., F. J., Chicago, Ill.
National Roofing Co., Tonawanda, N. Y.
Ruberoid Co., New York.
Sall Mountain Co., Chicago, Ill.
Sifo Products Co., St. Paul, Minn.
Sonneborn & Sons, Inc., L., New York.
United States Gypsum Co., Chicago, Ill.
Western Elaterite Roofing Co., Denver, Colo.

ROOFING, METAL
*Truscon Steel Co., Youngstown, O.
American Rolling Mill Co., Middletown, Ohio.
Berger Mfg. Co., Canton, O.
Edwards Mfg. Co., Cincinnati, O.
Klauer Mfg. Co., Dubuque, Ia.
Milwaukee Corrugating Co., Milwaukee, Wis.
Nat'l Sheet Metal Roofing Co., Jersey City, N. J
United Alloy Steel Corpn., Canton, O.
Youngstown Sheet & Tube Co., Youngstown, O.

ROOFING KETTLES. (See Kettles)

ROPE, MANILA
American Mfg. Co., Brooklyn, New York.
Columbian Rope Co., Auburn, N. Y.
Cuppies Cordage Co., Brooklyn, N. Y.
Hooven & Allison Co., Xenia, O.
Kelly Co., R. A., Xenia, O.
New Bedford Cordage Co., New Bedford, Mass.
Peoria Cordage Co., Peoria, Ill.
Plymouth Cordage Co., N. Plymouth, Mass.
Wall Rope Wks., New York.
Waterbury Co., New York.
Whitlock Cordage Co., New York.

ROPE, WIRE, HOISTING, HAULAGE
American Steel & Wire Co., Chicago, Ill.
Broderick & Bascom Rope Co., St. Louis, Mo.
Leschen & Sons Rope Co., A., St. Louis, Mo.
MacWhyte Co., Kenosha, Wis.
Moon Co., Geo. C., Garwood, N. J.
Roebling's Sons Co., J. A., Trenton, N. J.
Upson-Walton Co., Cleveland, O.
Waterbury Co., New York.
Wickwire Spencer Steel Corp., New York.
Williamsport Wire Rope Co., Williamsport, Pa.

RUBBER TIRES. (See Tires.)

RULES
*Lufkin Rule Co., Saginaw, Mich.

SAFETY TREADS. (See Treads, Safety)

SASH, ROLLED STEEL. (See Window Frames and Sash)

SAW RIGS, PORTABLE
Amer. Saw Mill Mach. Co., Hackettstown, N. J.
C. H. & E. Mfg. Co., Milwaukee, Wis.
Knickerbocker Co., Jackson, Mich.
Oshkosh Mfg. Co., Oshkosh, Wis.

SCARIFIERS
*Adams & Co., J. D., Indianapolis, Ind.
*Austin Western Road Mchy. Co., Chicago, Ill.
*Barber Asphalt Co., Philadelphia, Pa.
*Buffalo Springfield Roller Co., Springfield, O.
*Galion Iron Works & Mfg. Co., Galion, Ohio.
*Good Roads Mach. Co., Kennett Square, Pa.
*Huber Mfg. Co., Marion, O.
*Kinney Mfg. Co., Boston, Mass.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Stockland Road Mach. Co., Minneapolis, Minn.
*Universal Road Machinery Co., Kingston, N. Y.
Acme Road Mach. Co., Frankfort, N. Y.
Avery Co., Peoria, Ill.
Case Threshing Mach. Co., J. I., Racine, Wis.
Lyle Cul. & Rd. Equip. Co., Minneapolis, Minn.

SCARIFIERS, TEETH FOR
*Shunk Mfg. Co., Bucyrus, Ohio.

SCRAPERS, POWER DRAG
*Sauerman Bros., Chicago, Ill.

SCRAPERS, ROAD (See Road Scrapers)

SCRAPERS, SELF-LOADING
*Baker Mfg. Co., Springfield, Ill.
Smith & Sons Mfg. Co., Kansas City, Mo.

SCREENS, SAND, GRAVEL AND COAL
*Atlas Eng. Co., Milwaukee, Wis.
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Good Roads Mach'y Co., Kennett Square, Pa.
*Haiss Mfg. Co., Geo., New York.
*Littleford Bros., Cincinnati, O.
*Robins Conv. Belt Co., New York.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Universal Road Machinery Co., Kingston, N. Y.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Austin Mfg. Co., Chicago, Ill.
Bartlett & Snow Co., Cleveland, O.
Case Threshing Machine Co., J. I., Racine, Wis.
Chain Belt Co., Milwaukee, Wis.
Galion Iron Wks. & Mfg. Co., Galion, Ohio.
Gifford-Wood Co., Hudson, N. Y.
Hendrick Mfg. Co., Carbondale, Pa.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago, Ill.
Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
Newaygo Eng. Co., Newaygo, Mich.
New Jersey Wire Cloth Co., Trenton, N. J.
Sackett Screen & Chute Co., H. B., Chicago, Ill.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.
Wickwire Spencer Steel Corp., New York.

SCREENS, SEWAGE
Chain Belt Co., Milwaukee, Wis.
Link-Belt Co., Philadelphia, Pa.
Sanitation Corp'n, New York.

SCREWS
American Screw Co., Providence, R. I.
Clark Bros. Bolt Co., Millidale, Conn.
St. Louis Screw Co., St. Louis, Mo.

SEWAGE DISPOSAL APPARATUS
Direct Oxidation Disposal Corp., Phila., Pa.
Dorr Co., New York
Pacific Flush Tank Co., Chicago, Ill.
Sanitation Corp'n, New York.

SEWAGE PUMPS (See "Pumps, Centrifugal")

SEWAGE EJECTORS
Pacific Flush Tank Co., Chicago, Ill.
Sanitation Corp'n, New York.
Yeomans Bros. Co., Chicago, Ill.

SEWER BLOCKS, SEGMENT
American Vit. Products Co., Akron, O.
Cannelton Sewer Pipe Co., Cannelton, Ind.
Denver Sewer Pipe & Clay Co., Denver, Col.
Evens & Howard Fire Brick Co., St. Louis, Mo.
Dickey Clay Mfg. Co., W. S., Kansas City, Mo.
Laclede Christy Clay Products Co., St. Louis, Mo.
Macomb Sewer Pipe Wks., Macomb, Ill.
Pacific Clay Products Co., Los Angeles, Cal.
Red Wing Sewer Pipe Co., Red Wing, Minn.
Robinson Clay Product Co., Akron, O.
Standard Fire Brick & Sewer Pipe Co., Pueblo, Col.

SEWER CLEANING APPARATUS
Champion Corporation, Hammond, Ind.
Self Propelling Nozzle Co., New York.
Thompson Sewer Machine Co., Buffalo, N. Y.
Turbine Sewer Machine Co., Milwaukee, Wis.

SEWER PIPE AND DRAIN TILE
American Vit. Products Co., Akron, O.
Blackmer & Post Pipe Co., St. Louis, Mo.
Doe Co., Wm. E., Chicago, Ill.
Delaware Clay Products Co., Pittsburgh, Pa.
Denver Sewer Pipe & Clay Co., Denver, Col.
National Fireproofing Co., Pittsburgh, Pa.
Ohio Vitrified Pipe Co., Uhrichsville, O.
Robinson Clay Product Co., Akron, O.

SEWER RODS
Bissell Co., F., Toledo, O.
Champion Corporation, Hammond, Ind.
Turbine Sewer Machine Co., Milwaukee, Wis.

SHINGLES, METAL
Berger Mfg. Co., Canton, Ohio.
Canton Art Metal Co., Canton, Ohio.
Edwards Mfg. Co., Cincinnati, Ohio.
Eller Mfg. Co., Canton, Ohio.
Milwaukee Corrugating Co., Milwaukee, Wis.
Nat'l Sheet Metal Roofing Co., Jersey City, N. J.
Newport Rolling Mill Co., Newport, Ky.
Penn Metal Co., Boston, Mass.
Klauer Mfg. Co., Dubuque, Ia.
Tiffin Art Metal Co., Tiffin, Ohio.
Wheeling Metal Mfg. Co., Wheeling, W. Va.

SHOVELS, ELECTRIC
Bucyrus Co., South Milwaukee, Wis.
Marion Steam Shovel Co., Marion, O.
Thew Shovel Co., Lorain, O.

SHOVELS, GASOLINE
*Pawling & Harnischfeger Co., Milwaukee, Wis.
American Steel Dredge Co., Fort Wayne, Ind.
Austin Machinery Corp'n, Toledo, O.
Bay City Dredge Works, Bay City, Mich.
Fairbanks Steam Shovel Co., Marion, O.
Marion Steam Shovel Co., Marion, O.
Thew Shovel Co., Lorain, O.

SHOVELS, HAND
American Shovel & Stamping Co., Lorain, O.
Ames Shovel & Tool Co., Boston, Mass.
Beall Bros. Co., Alton, Ill.
Conneaut Shovel Co., Conneaut, O.
Hubbard & Co., Pittsburgh, Pa.
Indiana Shovel Co., New Castle, Ind.
Jackson Shovel Co., Montpelier, Ind.
Pittsburgh Shovel Co., Pittsburgh, Pa.
Russell Shovel Co., Aliquippa, Pa.
Stevens-Webb Co., Inc., Altoona, Pa.
Union Furnace Mfg. Co., Altoona, Pa.
Wood Shovel & Tool Co., Piqua, Ohio.
Wyoming Shovel Works, Wyoming, Pa.

SHOVELS, STEAM
*Austin Machinery Corp'n, Toledo, O.
*Keystone Driller Co., Beaver Falls, Pa.
*Osgood Co., The, Marion, O.
American Steel Dredge Co., Fort Wayne, Ind.
Bellwood Steam Shovel Co., Bellwood, Pa.
Browning Co., Cleveland, O.
Bucyrus Co., South Milwaukee, Wis.
Byers Machine Co., J. F., Ravenna, Ohio.
Erie Steam Shovel Co., Erie, Pa.
Fairbanks Steam Shovel Co., Marion, O.
Industrial Works, Bay City, Mich.
Marion Steam Shovel Co., Marion, O.
Smith Co., T. L., Milwaukee, Wis.
Thew Shovel Co., Lorain, O.

SIGNS, STREET AND ROAD
Baltimore Enamel & Novelty Co., Baltimore, Md.
Ingram-Richardson Mfg. Co., Beaver Falls, Pa.
Lyle-Signs, Minneapolis, Minn.
Municipal Products & Elec. Co., Buffalo, N. Y.
Municipal Street Sign Co., New York.
Nelke Sign Co., J. L., New York.
Safety Traffic Guide Co., Elkhart, Ind.
Union Iron Products Co., East Chicago, Ind.
Western Display & Mfg. Co., St. Paul, Minn.

SIGNS, TRAFFIC
Automatic Signal & Sign Co., Chicago, Ill.
Best Traffic Light Co., E. Peoria, Ill.
Elkhart Fdry. & Mach. Co., Elkhart, Ind.
Esaco Mfg. Co., Peoria, Ill.
Federal Signal Co., Albany, N. Y.
Ingram-Richardson Mfg. Co., Beaver Falls, Pa.
Lebanon Machine Co., Lebanon, N. H.
Little Giant Co., Mankato, Minn.
Lyle-Signs, Minneapolis, Minn.
Ohio Traffic Devices Co., Columbus, O.
Safety Traffic Guide Co., Elkhart, Ind.
Safety Traffic Lt. Co., Milwaukee, Wis.
Thompson-Fleming, Inc., Buffalo, N. Y.
Traffic Sign & Signal Co., Gloucester, Mass.
Union Iron Products Co., E. Chicago, Ind.

SLATE, ROOFING
Vendor Slate Co., Inc., Easton, Pa.

SLATE, STRUCTURAL
Keenan Structural Slate Co., Bangor, Pa.
Penna. Structural Slate Co., Easton, Pa.
Phœnix Slate Co., Windgap, Pa.
Structural Slate Co., Pen Argyl, Pa.

SLEEVES, TAPPING AND VALVE
Mueller Mfg. Co., Decatur, Ill.
Rensselaer Valve Co., Troy, N. Y.
Smith Mfg. Co., A. P., East Orange, N. J.

SLUICE GATES. (See Gates, Sluice.)

SMOKE STACKS. (See Stacks, Steel)

SNOW CLEANING MACHINERY
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Baker Mfg. Co., Springfield, Ill.
*Good Roads Mach. Co., Kennett Square, Pa.
*Holt Mfg. Co., Peoria, Ill.
*International Motor Co., New York.
Avery Co., Peoria, Ill.
Barber-Greene Co., Aurora, Ill.
Cleveland Tractor Co., Cleveland, Ohio.
Monarch Tractors, Inc., Watertown, Wis.
J. T. Tractor Co., Cleveland, O.
Toy Co., W. M., Sidney, Ohio.
Owensboro Ditcher & Grader Co., Owensboro, Ky.

SPRAYERS, ASPHALT AND TAR
*Kinney Mfg. Co., Boston, Mass.

SPRAYING MACHINERY FOR TREES
Bean Spray Pump Co., Lansing, Mich.
Deming Co., The, Salem, Ohio.
Field Force Pump Co., Elmira, N. Y.
Fitzhenry-Guptill Co., East Cambridge, Mass.

SPREADERS, STONE
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Burch Plow Works Co., Crestline, O.

STACKS, STEEL
*Blaw-Knox Co., Pittsburgh, Pa.
*Connery & Co., Inc., Philadelphia, Pa.
*Heil Co., The, Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
Chatta. Boiler & Tank Co., Chattanooga, Tenn.
Chicago Bridge & Iron Works, Chicago, Ill.
Honhorst Co., Jos., Cincinnati, O.
Petroleum Iron Works Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Scaife & Sons Co., Wm. B., Pittsburgh, Pa.
Walsh & Weidner Boiler Co., Chattanooga, Tenn.

STANDPIPES, TANKS AND TOWERS
*Connery & Co., Inc., Philadelphia, Pa.
Caldwell Co., W. E., Louisville, Ky.
Chattanooga Blr. & Tank Co., Chattanooga, Tenn.
Chicago Bridge & Iron Works, Chicago, Ill.
Lancaster Iron Wks., Lancaster, Pa.
Pacific Tank & Pipe Co., San Francisco, Cal.
Petroleum Iron Works Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
United Iron Works, Kansas City, Mo.
Walsh & Weidner Boiler Co., Chattanooga, Tenn.

STEAM SHOVELS. (See Shovels, Steam)

STEAM TURBINES
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
De Laval Steam Turbine Co., Trenton, N. J.
Ingersoll-Rand Co., New York.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

STEEL PLATE CONSTRUCTION
*Blaw-Knox Co., Pittsburgh, Pa.
*Connery & Co., Philadelphia, Pa.
*Heil Co., The, Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
Bethlehem Steel Co., Bethlehem, Pa.
Bigge Boiler Wks., Akron, O.
Chatta. Boiler & Tank Co., Chattanooga, Tenn.
Chicago Bridge & Iron Works, Chicago, Ill.
Graver Corporation, E. Chicago, Ind.
Heltzel Steel Form & Iron Co., Warren, O.
Hendrick Mfg. Co., Carbondale, Pa.
Honhorst Co., Jos., Cincinnati, Ohio.
McClintic-Marshall Co., Pittsburgh, Pa.
Pennsylvania Bridge Co., Beaver Falls, Pa.
Petroleum Iron Works Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Riter-Conley Co., Pittsburgh, Pa.
Scaife & Sons, Wm. B., Pittsburgh, Pa.
Toledo Crane Co., Toledo, O.
Union Iron Works, Hoboken, N. J.
Vulcan Iron Works, Jersey City, N. J.
Walsh & Weidner Boiler Co., Chattanooga, Tenn.

STOKERS, MECHANICAL
Automatic Furnace Co., Dayton, Ohio.
Babcock & Wilcox Co., New York
Combustion Engine Corp., New York
Detroit Stoker Co., Detroit, Mich.
Laclede-Christy Clay Prod. Co., St. Louis, Mo.
Murphy Iron Works, Detroit, Mich.
Sanford Riley Stoker Co., Worcester, Mass.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

STREET AND ROAD SIGNS. (See Signs, Street and Road.)

STREET CLEANERS' CARTS
Durlach Can & Iron Works, Brooklyn, N. Y.
Rochester Can Co., Rochester, N. Y.
Tarrant Mfg. Co., Saratoga Springs, N. Y.

STREET FLUSHERS AND SPRINKLERS
*Austin-Western Road Machy. Co., Chicago, Ill.
*General Motors Truck Co., Pontiac, Mich.
*Heil Co., The, Milwaukee, Wis.
*Kinney Mfg. Co., Boston, Mass.
*International Motor Co., New York.
*Municipal Supply Co., South Bend, Ind.
Autocar Co., Ardmore, Pa.
Etnyre & Co., E. D., Oregon, Ill.
Federal Motor Truck Co., Detroit, Mich.
Packard Motor Car Co., Detroit, Mich.
Pierce Arrow Motor Car Co., Buffalo, N. Y.
Tiffin Wagon Co., Tiffin, O.
White Co., Cleveland, O.

STREET LAMP POSTS
Clow & Sons, J. B., Chicago, Ill.
Drake Mfg. Co., Friendship, N. Y.
Electric Railway Equipment Co., Cincinnati, O.
General Electric Co., Schenectady, N. Y.
King Mfg. Co., Chicago, Ill.
Massey Concrete Products Co., Chicago, Ill.
Mott Iron Wks., J. L., New York
Union Metal Mfg. Co., Canton, O.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

STREET SIGNS (See Signs, Street)

STREET SWEEPERS
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Good Roads Mach. Co., Kennett Square, Pa.
*Universal Road Machinery Co., Kingston, N. Y.
Elgin Sales Corp'n, New York.
Foamite-Childs Corp., Utica, N. Y.
Springfield Motor Sweeper Co., Springfield, O.

STREET SWEEPING BROOMS
*Littleford Bros., Cincinnati, O.
Holcomb Mfg. Co., J. I., Indianapolis, Ind.
Ind. Brush & Broom Mfg. Co., Indianapolis, Ind.
Kendallville Broom & Brush Co., Kendallville, Ind.
Lang Broom Co., Pittsburgh, Pa.
Lay Co., Jos., Ridgeville, Ind.
Milwaukee Brush Mfg. Co., Milwaukee, Wis.
Osborn Mfg. Co., Cleveland, Ohio.

STREET SWEEPING BROOMS REFILLED
Kendallville Broom & Brush Co., Kendallville, Ind.
Lang Broom Co., Pittsburgh, Pa.

STRUCTURAL STEEL AND IRON. (See Bridges and Buildings)

STUMP PULLERS
Bennett & Co., H. L., Westerville, O.
Clyde Iron Works, Duluth, Minn.
La Plant-Choate Mfg. Co., Cedar Rapids, Ia.
Thomas Elevator Co., Chicago, Ill.

SUPERHEATERS
Babcock & Wilcox Co., New York.
Power Specialty Co., New York.
Superheater Co., New York.

SURVEYORS' INSTRUMENTS. (See Instruments.)

SWITCHBOARDS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Wagner Elec. Mfg. Co., St. Louis, Mo.
Westinghouse Elec. & Mfg.Co.,E. Pittsburgh, Pa.

TABLES AND BOARDS, DRAWING. (See Drawing Materials.)

TAMPING MACHINES

*Pawling & Harnischfeger Co., Milwaukee, Wis.
Construction Mach'y Co., Waterloo, Ia.
Ingersoll-Rand Co., New York

TANKS, AIR COMPRESSOR

*Connery & Co., Inc., Philadelphia, Pa.
*Heil Co., Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
Abendroth & Root Mfg. Co., New York.
Biggs Boiler Wks., Akron, O.
Chicago Bridge & Iron Works, Chicago, Ill.
Chicago Pneumatic Tool Co., New York
Graver Corporation, E. Chicago, Ind.
Indiana Air Pump Co., Indianapolis, Ind.
Ingersoll-Rand Co., New York.
Lancaster Iron Wks., Lancaster, Pa.
National Tube Co., Pittsburgh, Pa.
Petroleum Iron Works Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Scaife & Sons Co., W. B., Pittsburgh, Pa.
Westinghouse Tract. Brake Co., Wilmerding, Pa.
Worthington Pump & Machy. Corp., New York.

TANKS, STEEL

*Connery & Co., Philadelphia, Pa.
*Heil Co., Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
Avery Co., Peoria, Ill.
Biggs Boiler Wks., Akron, O.
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Case Threshing Mach. Co., J. I., Racine, Wis.
Caldwell Co., W. E., Louisville, Ky.
Chatta. Boiler & Tank Co., Chattanooga, Tenn.
Chicago Bridge & Iron Works, Chicago, Ill.
Columbian Steel Tank Co., Kansas City, Mo.
Dover Boiler Wks., New York.
Farrell Mfg. Co., Joliet, Ill.
Fouts Co., C. C., Middletown, O.
Graver Corporation, E. Chicago, Ind.
Hardesty Mfg. Co., R., Denver, Col.
Hendrick Mfg. Co., Carbondale, Pa.
Honhorst Co., Jos., Cincinnati, Ohio.
Lancaster Iron Works, Lancaster, Pa.
Pacific Tank & Pipe Co., San Francisco, Cal.
Petroleum Iron Works Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Riter-Conley Co., Pittsburgh, Pa.
Scaife & Sons, Wm. B., Oakmont, Pa.
United Iron Works, Kansas City, Mo.
Walsh & Weidner Boiler Co., Chattanooga, Tenn.
Wayne Tank & Pump Co., Ft. Wayne, Ind.

TANKS, WOOD

Caldwell Co., W. E., Louisville, Ky.
Davis & Son, G. M., Palatka, Fla.
Eagle Tank Co., Chicago, Ill.
Hauser-Stander Tank Co., Cincinnati, O.
Kalamazoo Tank & Silo Co., Kalamazoo, Mich.
National Tank & Pipe Co., Portland, Ore.
Pacific Tank & Pipe Co., San Francisco, Cal.
Redwood Manufacturers Co., San Francisco, Calif.
Stearns Lumber Co., A. T., Boston, Mass.
U. S. Wind Engine & Pump Co., Batavia, Ill.
Wendnagel & Co., Chicago, Ill.

TANK WAGONS

*Heil Co., Milwaukee, Wis.
*International Motor Co., New York.
Acme Road Mach. Co., Frankfort, N. Y.
Avery Co., Peoria, Ill.
Case Threshing Mach. Co., J. I., Racine, Wis.

TAPES, STEEL AND METALLIC

*Lufkin Rule Co., Saginaw, Mich.
Dietzgen Co., Eugene, New York.
Keuffel & Esser Co., Hoboken, N. J.
Starrett, L. S., Athol, Mass.

TAPPING MACHINES

Hays Mfg. Co., Erie, Pa.
Mueller Mfg. Co., H., Decatur, Ill.
Smith Mfg. Co., A. P., E. Orange, N. J.

TAR AND TARVIA

*Barrett Co., New York
American Tar Products Co., Chicago, Ill.

TAR KETTLES. (See Kettles)

TIES, STEEL

*Koppel Ind. Car & Equip. Co., Koppel, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Sweet's Steel Co., Williamsport, Pa.

TIMBER CLAMPS

Pyle-Rogers Corp., New York.

TIRES, RUBBER. (For Motor Trucks.)

*Goodrich Rubber Co., Akron, O.
Firestone Tire & Rubber Co., Akron, O.
Fisk Tire Co., Akron, O.
Goodyear Tire & Rubber Co., Akron, O.
Kelly Springfield Tire Co., New York.
Republic Rubber Co., Youngstown, O.
U. S. Tire Co. New York.

TOOL HOUSES, PORTABLE STEEL

*Littleford Bros., Cincinnati, O.

TOWERS (See Standpipe Tanks and Towers)

TRACKS, INDUSTRIAL AND PORTABLE

*Koppel Ind. Car & Equip. Co., Koppel, Pa.
Atlas Car & Mfg. Co., Cleveland, Ohio.
Bethlehem Steel Co., Bethlehem, Pa.
Chase Fdry. & Mfg. Co., Columbus, O.
Easton Car & Constn. Co., New York.
Hunt Co., Inc., C. W., West New Brighton, N. Y.
Lakewood Engineering Co., Cleveland, O.

TRACTORS

*Bear Tractors, Inc., New York
*Best Tractor Co., C. L., San Leandro, Cal.
*Ford Motor Co., Detroit, Mich.
*Holt Mfg. Co., Peoria, Ill.
*Huber Mfg. Co., Marion, O.
*International Motor Co., New York.
Advance-Rumely Thresher Co., Laporte, Ind.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Avery Co., Peoria, Ill.
Barrett-Cravens Co., Chicago, Ill.
Bates Machine & Tractor Co., Joliet, Ill.
Case Threshing Machine Co., J. I., Racine, Wis
Clark Tracktractor Co., Chicago, Ill.
Cleveland Tractor Co., Cleveland, O.
Dayton-Dowd Co., Quincy, Ill.
Fairbanks, Morse & Co., Chicago, Ill.
Four Wheel Drive Auto Co., Clintonville, Wis.
Hart-Parr Co., Charles City, Iowa.
International Harvester Co., Chicago, Ill.
J. T. Tractor Co., Cleveland, O.
Little Giant Co., Mankato, Minn.
Moline Plow Co., Rock Island, Ill.
Monarch Tractors, Inc., Watertown, Wis.
Oliver Tractor Co., Knoxville, Tenn.
Shaw-Enochs Tractor Co., Minneapolis, Minn.
Tioga Tractor Co., Baltimore, Md.
Twin City Co., Minneapolis, Minn.
White Company, The, Cleveland, O.

TRAFFIC LINE MARKERS

Line-O-Graph Co., New York.
Spray Engineering Co., Boston, Mass

TRAFFIC PAINT

Hoosier Paint Wks., Ft. Wayne, Ind.
Sewall Paint & Glass Co., Kansas City, Mo.
Tropical Paint & Oil Co., Cleveland, Ohio.
Truscon Laboratories, Detroit, Mich.

TRAFFIC SIGNS. (See "Signs, Traffic")

TRAILERS FOR TRUCKS AND TRACTORS

*Whitehead & Kales Co. Detroit, Mich.
Arcadia Trailer Corp., Newark, N. Y.
Eagle Wagon Works, Auburn, N. Y.
Highway Trailer Co., Edgerton, Wis.
La Plant-Choate Mfg. Co., Cedar Rapids, Ia.
Lee Trailer & Body Co., Chicago, Ill.
Troy Wagon Works, Troy, O.
Warner Mfg. Co., Beloit, Wis.
Watson Products Corp'n., Canastota, N. Y.

TRAILERS, INDUSTRIAL

Chase Fdry. & Mfg. Co., Columbus, O.
Electric Wheel Co., Quincy, Ill.
Lakewood Engineering Co., Cleveland, O.
Lee Trailer & Body Co., Chicago, Ill.

TRAMWAYS, AERIAL WIRE ROPE

Broderick & Bascom Rope Co., St. Louis, Mo.
Leschen & Sons Rope Co., A., St. Louis, Mo.

TRANSFORMERS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Duncan Elec. Mfg. Co., Lafayette, Ind.
General Electric Co., Schenectady, N. Y.
Kuhlman Electric Co., Bay City, Mich.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa

TRANSITS AND LEVELS. (See Instruments.)

TRANSMISSION. (Auxiliary for Ford Trucks.)
*Warford Corpn., New York.

TRANSMISSION MACHINERY, POWER
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Chain Belt Co., Milwaukee, Wis.
Dodge Mfg. Corp'n, Mishawaka, Ind.
General Electric Co., Schenectady, N. Y.
Link-Belt Co., Chicago, Ill.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

TRASH CANS. (See Cans)

TREADS, SAFETY
American Abrasive Metals Co., New York.
American Mason Safety Tread Co., Lowell, Mass.
Concrete Steel Co., New York.
Hendrick Mfg. Co., Carbondale, Pa.
Norton Co., Worcester, Mass.

TRENCH BRACES. (See Braces, Trench)

TRENCH EXCAVATORS, (see Excavators, Ditch & Trench)

TRENCH PUMPS. (See Pumps, Contractors')

TURBINES
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
De Laval Steam Turbine Co., Trenton, N. J.
General Electric Co., Schenectady, N. Y.
Ingersoll-Rand Co., New York.
Midwest Engine Co., Indianapolis, Ind.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

TURNTABLES FOR MOTOR TRUCKS
*Blaw-Knox Co., Pittsburgh, Pa.
Champion Eng. Co., Kenton, O.
Freeman Mfg. Co., Racine, Wis.
The Hug Co., Highland, Ill.
Western Structural Co., Moline, Ill.

USED MACHINERY
(See Contractors' Used Equipment.)

VALVE CONTROL APPARATUS, ELECTRIC
Payne Dean, Ltd., New York.

VALVES, CHECK
*Ludlow Valve Mfg. Co., Troy, N. Y.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Michigan Brass & Iron Co., Detroit, Mich.
Rensselaer Valve Co., Troy, N. Y.

VALVES, GATE AND INDICATOR POSTS
*Ludlow Valve Mfg. Co., Troy, N. Y.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Columbian Iron Wks., Chattanooga, Tenn.
Crane Company, Chicago, Ill.
Darling Valve & Mfg. Co., Williamsport, Pa.
Eddy Valve Co., Waterford, N. Y.
Fairbanks Co., The, New York.
Iowa Valve Co., Oskaloosa, Ia.
Kennedy Valve Mfg. Co., Elmira, N. Y.
Lunkenheimer Co., Cincinnati, O.
Reading Steel Casting Co., Inc., Bridgeport, Conn.
Rensselaer Valve Co., Troy, N. Y.
Smith Mfg. Co., A. P., East Orange, N. J.
Wood & Co., R. D., Philadelphia, Pa.

VALVE BOXES AND HOUSINGS
*Central Foundry Co., New York.
*Clark Co., H. W., Mattoon, Ill.
*Ludlow Valve Co., Troy, N. Y.
*U. S. C. Ir. Pipe & Fdry. Co., Burlington, N. J.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Clow & Sons, J. B., Chicago, Ill.
Columbian Iron Works, Chattanooga, Tenn.
Darling Valve & Mfg. Co., Williamsport, Pa.
Eddy Valve Co., Waterford, N. Y.
Fairbanks Co., The, New York.
Iowa Valve Co., Oskaloosa, Ia.
Kennedy Valve Mfg. Co., Elmira, N. Y.
Mueller Mfg. Co., H., Decatur, Ill.
Pratt & Cady Co., Inc., Hartford, Conn.
Rensselaer Valve Co., Troy, N. Y.
Smith Mfg. Co., A. P., East Orange, N. J.
Wood & Co., R. D., Philadelphia, Pa.

VENTILATORS
American Blower Co., Detroit, Mich.
Edwards Mfg. Co., Cincinnati, O.
Milwaukee Corrugating Co., Milwaukee, Wis.

WAGONS. (See Dump Carts and Wagons.)

WAGON BODIES. (See Dump Bodies)

WAGON LOADERS. (See Loaders, Gravel and Wagon)

WALLBOARD
*Carey Co., Philip, Cincinnati, Ohio.
Beaver Board Companies, Buffalo, N. Y.
Bird & Son, inc., E. Walpole, Mass.
Cornell Wood Products Co., Chicago, Ill.
Haverhill Box Board Co., Haverhill, Mass.
MacAndrews & Forbes Co., New York, N. Y.
Plastergon Wall Board Co., Buffalo, N. Y.
United States Gypsum Co., Chicago, Ill.
Upson Co., The, Lockport, N. Y.
Waldorf Paper Products Co., St. Paul, Minn.

WALL TIES
Concrete Steel Co., New York, N. Y.
Consolidated Expanded Metal Co., Braddock, Pa.
Berger Mfg. Co., Canton, O.
Milwaukee Corrugating Co., Milwaukee, Wis.
Niagara Metal Stamp. Corp., Niagara Falls, N. Y.

WATER MAIN CLEANING
*National Water Main Cleaning Co., New York.

WATER MAIN TAPPING MACHINES
Mueller Mfg. Co., H., Decatur, Ill.
Smith Mfg. Co., A. P., East Orange, N. J.

WATER METERS. (See Meters, Water.)

WATERPROOFING COMPOUNDS AND MATERIAL
*Barber Asphalt Co., Philadelphia, Pa.
*Carey Co., Philip, Cincinnati, Ohio.
*Standard Oil Co. (Indiana), Chicago, Ill.
*Texas Company, New York.
Anti-Hydro Waterproofing Co., Newark, N. J.
Atlantic Refining & Asphalt Corp., Phil'a, Pa.
Barrett Company, New York.
General Fireproofing Co., Youngstown, O.
Master Builders' Co., Cleveland, O.
Minwax Co., The, New York.
Protexol Corpn., New York.
Ruberoid Co., New York.
Sandusky Cement Co., Cleveland, O.
Servicised Products Co., Chicago, Ill.
Sonneborn Sons, Inc., New York.
Tock Brothers, New York.
Truscon Laboratories, Detroit, Mich.

WATER PURIFICATION. (See also Filters.)
*Wallace & Tiernan Co., Inc., Newark, N. J.
R. U. V. Company, New York.

WATER REGULATORS
*Union Water Meter Co., Worcester, Mass.
Mueller Mfg. Co., Decatur, Ill.
Pacific Flush Tank Co., Chicago, Ill.

WATER SOFTENERS
American Water Softener Co., Philadelphia, Pa.
Graver Corporation, E. Chicago, Ind.
International Filter Co., Chicago, Ill.
N. Y. Continental Jewell Filtr. Co., Nutley, N. J.
Permutit Company, New York.
Roberts Filter Mfg. Co., Darby, Pa.
Scaife & Sons, W. B., Pittsburgh, Pa.
Wayne Tank & Pump Co., Ft. Wayne, Ind.

WATER WASTE DETECTION
*Clark & Co., H. W., Mattoon, Ill.
*Pitometer Co., New York
Simplex Valve & Meter Co., Philadelphia, Pa.

WATER WHEELS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Leffel & Co., Jas., Springfield, O.
Pelton Water Wheel Co., San Francisco, Cal.
Smith Company, S. Morgan, York, Pa.

WATER WORKS PUMPS (See "Pumps, Centrifugal" and "Pumps, Deep Well")

WELDING APPARATUS
General Electric Co., Schenectady, N. Y.
Lincoln Electric Co., Cleveland, O.
Milburn Company, Alex., Baltimore, Md.
Oxweld Acetylene Co., Newark, N. J.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

WELL SCREENS
Cook, Inc., A. D., Lawrenceburg, Ind.
Johnson, Edw. E., Inc., St. Paul, Minn.

WELLS, CONCRETE
Kelly Well Co., Grand Island, Neb.

WELL-DRILLING AND BLAST HOLE MACHINES
*Keystone Driller Co., Beaver Falls, Pa.
American Well Works, Aurora, Ill.
Armstrong Mfg. Co., Waterloo, Iowa.
Leidecker Tool Co., Marietta, Ohio.
Loomis Machine Co., Tiffin, Ohio.
Sanderson Cyclone Drill Co., Orrville, Ohio.
Sparta Iron Wks. Co., Sparta, Wis.
Star Drilling Machine Co., Akron, O.

WHEELBARROWS
*Puffer-Hubbard Mfg. Co., Minneapolis, Minn.
Akron Barrow Co., Cleveland, O.
Jackson Mfg. Co., Harrisburg, Pa.
Lansing Co., Lansing, Mich.
Sidney Steel Scraper Co., Sidney, O.
Sterling Wheelbarrow Co., Milwaukee, Wis.
Stoubner Iron Wks., G. L., L. I. City, N. Y.
Toledo Wheelbarrow Co., Toledo, O.

WINCHES
Bethlehem Shipbuilding Corp., Bethlehem, Pa.
Chisholm-Moore Mfg. Co., Cleveland, O.
Clyde Iron Wks., Duluth, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Lidgerwood Mfg. Co., New York.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Mundy Hoisting Eng. Co., J. S., Newark, N. J.

WINDOW FRAMES AND SASH. (Metallic.)
*Truscon Steel Co., Youngstown, O.
Bayley Co., Wm., Springfield, O.
Detroit Steel Products Co., Detroit, Mich.
Friedrich Co., E. H., Holyoke, Mass.
Lupton's Sons Co., David, Philadelphia, Pa.
McFarland Co., J. C., La Porte, Ind.
Penn Metal Co., Boston, Mass.
Sykes Co., Chicago, Ill.

WIRE AND CABLE
American Steel & Wire Co., Chicago, Ill.
Copper Clad Steel Co., Rankin, Pa.
General Electric Co., Schenectady, N. Y.
Habirshaw Elec. Cable Co., Inc., N. Y.
Hazard Mfg. Co., Wilkesbarre, Pa.
Macwhyte Co., Kenosha, Wis.
National India Rubber Co., Bristol, R. I.
New York Insulated Wire Co., New York.
Okonite Co., Passaic, N. J.
Roebling's Sons Co., J. A., Trenton, N. J.
Safety Ins. Wire & Cable Co., New York.
Simplex Wire & Cable Co., Boston, Mass.
Standard Underground Cable Co., Pittsburgh, Pa.
Tubular Woven Fabric Co., Pawtucket, R. I.
Waterbury Co., New York.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE GLASS
Mississippi Wire Glass Co., New York.

WIRE MESH REINFORCEMENT
*Truscon Steel Co., Youngstown, O.
American Steel & Wire Co., Chicago, Ill.
National Steel Fabric Co., Pittsburgh, Pa.
Wickwire Spencer Steel Corp., New York.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE ROPE. (See Rope, Wire.)

WOOD BLOCKS (See Paving Blocks)

WOODWORKING MACHINES
*Ransome Concrete Mach. Co., Dunellen, N. J.
Fairbanks, Morse & Co., Chicago, Ill.

WOOD PRESERVATIVES
Barrett Company, New York.
Protexol Corpn., New York.
Republic Creosoting Co., Indianapolis, Ind.
Truscon Laboratories, Detroit, Mich.

WRECKING BARS
Anderson Bros. Mfg. Co., Rockford, Ill.

WRENCHES
Erie Tool Works, Erie, Pa.
Greene, Tweed & Co., New York.
Greenfield Tap & Die Corp., Greenfield, Mass.
Lowell Wrench Co., Worcester, Mass.

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Economic Aspects of Day-Labor Construction

By Arthur S. Bent

Bent Brothers, Contractors, Los Angeles, Calif.

THE problem under consideration is not hypothetical. All over the country to-day there is a growing tendency among public officials to do public work by day labor. This is not confined to maintenance or to minor municipal operations, but reaches to single major projects of great importance. River levees built by the Federal Government, highways built by states, dams and canals built by irrigation districts, asylums and hospitals by counties, schools, sewers and paving by cities—all by day labor. The real causes of this tendency are not easy to determine, but the reasons given by public officials are quite simple and specific. Chiefly, they are: first, to save the contractor's profits; next, to permit of more elasticity in carrying on the work—under the day-labor method the responsibility upon the governing bodies of knowing what they are going to do, and how, does not press heavily; next, work can be started quicker. But back of these and other reasons lie basic causes which are not so easy to get at. Sometimes it is a desire for power and the support in authority which comes from a large body of subservient employees. Sometimes it is just politics of the old, sordid variety, less common now, but not yet gone from public life. To some extent it is traceable to a tendency toward socialism. Sometimes there is genuine discontent with contractors, or distrust of them. And let us in fairness say that sometimes it comes from a sincere impulse to save money.

In Secretary Hoover's last Year Book this statement appears: "Construction in the United States in 1922 exceeded five billions of dollars, equaling the combined value of wheat, corn, oats, barley and rye, almost equaling the net operating receipts of all the railroads in the United States, and exceeding by 50 per cent the total exports of this country. Activities in construction bear a close relation to general business conditions.

S. W. Straus in a recent White House conference said: "There is potential need for eight billion dollars' worth of new buildings in the United States to-day. The nation's volume of building for 1924 will reach five billions and all of this is just so much new capital created to contribute its share of federal, state and city taxes."

The general contractor is the product of evolution plus personal ability and character. Slowly, step by step, he has climbed the hard road; he has had many downfalls, but he has learned much and paid with his own money for every lesson. Through much experience he has ac-

A Statement by J. J. Davis, Secretary of Labor

"More than eleven millions of our people are dependent for their living upon the construction industry, and 22 per cent of all the skilled and unskilled labor of the country is engaged in the building branch alone. Some 250,000 freight cars are required to handle the material. Our building bill is $200 per year for each family in the United States. It is truly the chief barometer of the business of the country. When construction gains, prosperity is with us. It is the great outstanding influence for good or bad in our financial progress."

Two Fundamental Questions

First, has the evolution of this tremendous construction activity which touches so vitally every human life, developed an adequate specialized ability, either executive or technical? Second, is that ability essential to its orderly progress?

cumulated knowledge which can come in no other way, and he has acquired precedent to guide him through all his difficulties. He knows what tools will best work out his plans and how to use them; he has developed a keen judgment of men and their fitness, and through his acquired ability to guide and inspire them he has built up a specialized and dynamic organization. Along with his skill he has developed integrity and responsibility, so that he absorbs within himself the consequences of such mistakes as he may make and even such misfortunes as befall his work, and he is constantly spurred to his maximum efficiency by the necessities of his own financial responsibility. He delivers the goods, the kind he promised at the price he agreed. He has rightly been called "civilization's great tool."

Whom do the advocates of day-labor work ask us to take in his stead for handling the 5,000 million dollars we will put into construction this year? A politician placed in office by a campaign in which his ability as a construction manager was not even remotely considered. He holds that office for a limited time until a new but similar official will take his place. He has no organization, no plans, no experience, and frequently so little executive ability that the business world has passed him by and public office is the best job he can get.

This official, so poorly equipped that he would never undertake the work with his own capital if he had any, says to the city or to the state, "Let me have this ten-million bond issue and I will build the highway or the seawall or the aqueduct or the city hall and save you all the contractor's profits. True, I have no financial responsibility, but I want to try it, anyway. I have had no experience, I never undertook an important project of any kind, and I admit that probably no contractor would want me as his manager for this job, but there's no reason why I can't hire the same men that he hires and get as good foremen and superintendents as his and buy materials just as cheap. That's all there is to it. Then, too, the inspection expense will be nominal because nobody will cheat, and the engineering will cost much less because we don't have to get our plans ready in advance—we can start and then work them out as we go along. It is true I only think I can do all this, and if I miss my guess you will have to foot the bill. I can't give you any guarantee. Of course, I don't propose to put up a bond. I couldn't get one if I wanted to, but—let's go."

Now does anyone really question the proper choice between these methods from the standpoint of economics? Can any of us doubt the pernicious effect of this phase of socialism upon the morale of our people? Is anyone really ignorant of the inevitable answer which history has already given?

It is a commonplace to say that we all recognize the propriety and necessity of a certain amount of day-labor work. Any emergency can best be met by this method. Most maintenance work should be so carried on, and there are rare cases where the conditions indicate it for major operations. But in spite of such notable instances of successful construction as the Miami Conservancy District and the Los Angeles Aqueduct, the prosecution of public work by day labor has been a long story of waste of public money and the development of inefficiency.

In the joint report of the two great California Automobile Clubs may be found the statement that of 300 highways jobs done by day labor and amounting to seven millions of dollars, the state account showed unit costs on only five jobs. On two of these five jobs, the state first called for bids and rejected them on recommendation of the state engineer, who then undertook the work himself. The record shows the following figures:

	Engineer's Estimate	Contractor's Bid	Actual Cost to State
Excavating	.55	1.10	1.17 per cu. ft.
Concrete	4.50	7.50	10.38 " " yd.

In totals this means on the first job a bid of $117,000 and an actual cost of $160,000, or a loss to the state of over 37 per cent, and on the second job a bid of $43,000 and a cost of $81,000, or a loss to the state of almost 90 per cent. It is gratifying to add that the present California administration went into office under a pledge to stop this reckless waste and to carry on its public construction under public competition and firm contracts protected by surety bonds.

Day-labor work never has and never will develop the full efficiency and close economy which are the very heart of every successful contractor's history. Competent examinations of even the most conspicuous examples of apparently successful day-labor undertakings in this country would probably reveal not only an unnecessary cost, but the further fact that the engineers did not hold themselves to the methods or standards they would have demanded of the contractor. On a certain well-known important construction the firm of Bent Brothers was specifically instructed by the chief engineer that our bid must be based upon aggregates obtained by opening up a remote quarry and crushing both rock and sand, because the aggregates along the job were not suitable, but when he decided to do the job himself, he used the forbidden material exclusively, and on completion announced in public print a saving which in matter of fact was much less than the amount we had added for the quarrying and hauling. His answer was, "Well, I could safely do things that I could not permit under a contract." The maintenance gang that has been kept on that particular piece of work ever since is another story.

I also emphatically deny the soundness of the familiar argument for day labor that it removes the incentive for slighting and insures better quality of work, and assert from my observation that just the opposite is true. Contractors in all lines of construction are constantly held up to the details of meticulous standards and specifications which no engineer or architect imposes upon himself. The engineer has no public authority to criticize his

own work. This is not a proper basis for public construction.

Neither will the public mind concede much favor to the other chief argument that day labor permits the engineer to enter upon the work without the necessity of first preparing his plans. Great emergencies may occasionally justify such procedure, but as a method it is improper and unsound and leads to careless estimates and increased costs. It would be as proper to allow a contractor to plan the job one tool at a time, as his need arose, as it is for an engineer to enter upon it before he has made the fullest possible study and worked out his plans to completion.

The fundamental and glaring unsoundness in the day-labor method of expending public funds lies in the utter lack of responsibility back of the estimate and hopes of the officials in charge. It seems axiomatic that the taxpayer is entitled to assurance as to the ultimate cost of public work. The best of intentions and the most honest efforts on the part of officials are a poor substitute for guaranteed costs and financial responsibility. The taxpayers of the country would not knowingly put this option into the hands of the ever shifting stream of politicians who pass through our public offices. When public works are built by day labor, the taxpayer very rarely knows the actual cost. Such statements as are made public are seldom a true picture. Overhead is not fully charged, equipment is shifted from other departments without charge, automobiles are used without charge, equipment is credited at the close of the job at a price above its actual salvage value. Repairs of equipment are charged elsewhere. Telephones, telegrams, trips, postage, automobile supplies, general office work and depreciation are omitted or charged to general accounts. If public officials really do make savings in construction work, why are they not eager to publish full reports which will stand the test of expert auditing? Why is it so universally difficult to dig out the real costs of such work from your city hall or your state capitol? Why do public officials always resist the adoption of state laws which would bring their construction costs fairly into public contrast with contractors' bids?

It was only after years of struggle and defeat that in California we finally secured quite recently the adoption of a law which requires public officials to file upon completion sworn statements of their day-labor construction costs and to include therein repairs, insurance, transportation, rentals, depreciation and all other costs entering into the work; also to set forth the original estimated costs, together with the bids if any were taken, and a list of the publicly owned equipment used on the work and any changes in the original plans and specifications. Why was this wise, wholesome bill strenuously resisted? Isn't it certain that any public official who really effected savings by his construction department would eagerly welcome publicity therefor? Yet quite generally they oppose all efforts to check their costs—costs which are nearly always hopelessly buried in books of general accounts.

The contract method is time-honored and sound. It is based upon well-established economic truths; its competition develops low cost and enforces high efficiency. It furnishes the guarantee and responsibility upon which the safe financing of construction projects must rest. Such evils as it has from the public's point of view are not inherent in the method. They are solely the result of the failure of owners to demand skill, integrity and responsibility in their contractors.

The day-labor system is fundamentally unsound. It breeds dangerous politics, encourages inefficiency, lowers construction standards, develops extravagance, decreases production, destroys individuality and lets loose that spirit of disloyalty to duty that notoriously during the war spread like a plague over the whole world. We all need the spur of competition. We all need to feel the pressure of definite responsibility. We all need the rewards of individual initiative and effort. America's splendid and amazing career fairly rests on that foundation. Listen to the words of that discouraged prophet of day labor and communism, Leon Trotsky, as they appeared recently in the *Literary Digest*: "Our nationalized industries, even those working under exceptionally favorable auspices and well equipped, all are working at a loss. Our administrators and dictators are not real masters who attend to every little detail, who watch everything, who save every minute of time and every cent of money, who work day and night caring for the needs of our plants." The same false theory upon which day labor rests has benumbed the great soul of Russia, and not even her vast resources, greater than our own, will restore her.

Study by contrast the stirring words of the President of the Chamber of Commerce of the United States, Julius H. Barnes: "It is the American conviction that private enterprises and individual initiative are very precious things in national life which translate themselves into national progress. Consciously or unconsciously, American industry knows that its peculiar philosophy which stimulates the effort of the individual through assurance of a fair field and a secure reward for superior service has become the main strength of American accomplishment and we will not permit unchallenged the loud-spoken claims of those who would write into the American structure principles destructive of individual incentive and effort. Socialism leads to the easy theory of public service rendered without account of cost. We should not remain silent when theorists in public life propose to displace the sturdy philosophy of individual accomplishments with the easy social theory of the care of the state without that responsibility. If we can read intelligently the lesson of our national progress, a progress which after all is only the aggregate of individual effort, stimulated by fairness of opportunity and sureness of reward, then America may face the future without misgiving."

ACKNOWLEDGMENT.—From an address delivered at the Fifth Annual Meeting of the Associated General Contractors of America, Chicago, Ill.

The Cheapening of Danger Signals on Highways

By J. S. Walton

J. S. Walton & Co., Inc., General Contractors, Princeton, Ky.

IN the December, 1923, issue of CONTRACTORS' & ENGINEERS' MONTHLY, there is a timely article discussing the frequent disregard of danger signals displayed by contractors on their work.

It is the belief of the writer that the average motorist's conception of the value of a red light has been cheapened by the indiscriminate use of red lights on highways merely as warning or caution signals and not as positive stop or danger signals. Some highways are highly illuminated at night by all kinds of red lights, some fixed, some flashing at intervals, and others depending on the automobile's headlight to illuminate them by reflection. Fully 90 per cent of these red lights do not mean positive danger at all. They are merely intended to caution the driver to go slowly around a sharp curve, or that he is approaching a crossroads or some other place at which particular caution is necessary. The rest of these red lights display a fixed or flashing red light at really dangerous railroad grade crossings regardless of whether the crossing is really dangerous at the moment by reason of the approach of a train or not. Consequently, when the automatic flashing red light displayed by the railroad only upon the approach of a train is seen, it is often taken by an unobservant driver as merely another of the dozens of red caution signals he has passed back on the road.

It would be a great help if the state highway departments of the entire country would cooperate in the adoption of standard color signals. RED should only be displayed when actual stop is meant; ORANGE lights should be used as a caution signal at sharp curves or anywhere else where it is meant for the motorist to slow down and be prepared for possible danger; and GREEN lights should be used as a clear signal to go ahead.

Such a standardization of signals would be appreciated very quickly by the traveling public, and they would have a much greater respect for a red light if they knew that certain disaster would result from running by them. There is no doubt that the adoption of some such practice would result in saving many a life, and would also be sincerely appreciated by contractors who display red lights on stock piles, at barricades and other points which are really dangerous for traffic to pass.

Slipshod Contracts

DURING the last construction season many instances have come to our attention where serious disagreements arising between constructors, their "subs" and others, have been due to failure of all parties to reduce these agreements to specific form. Verbal understandings are exceedingly dangerous. The telephone, automobile, steam shovel, paving mixer and other time-saving devices, have so increased the volume of work which it is possible for a construction executive to oversee in a given time that individual business affairs constantly tend to outgrow the limitations of memory and become, increasingly, a matter of accurate recording and reference to correspondence and other written forms.

Under these conditions the methods followed by our ancestors, in covering a small fraction of the intensive activity incident to modern business life, are archaic and not to be depended upon. With the best of intentions, we are prone to forget, in the hurry and multiplicity of our transactions, the details of business agreements, or to place upon them, after a lapse of time and memory, an interpretation which was not implied when they were consummated. Situations have arisen where constructors have been forced to make payments to subcontractors totaling thousands of dollars where no such payments were contemplated by either party in the original agreements. Incidents involving equal culpability of constructors are not wanting. Cases likewise abound where constructors have been forced to assume heavy burdens not contemplated in their contracts with owners, merely because of failure to insist upon a specific written agreement from engineers, covering changes in contracts.

It is astonishing to note how many highway constructors still insist upon doing business in this way. Investigations of many complaints which have come to the attention of our associations have revealed the fact that parties involved were either working under verbal agreements or instructions, or other slipshod forms of contract. Successful handling of such matters is more often than otherwise the result of patient and unremitting forethought and attention to all details in the first instance, and a black-and-white statement is the best method for forestalling trouble. The "dear old dollar mark" lies at the root of a large percentage of all business troubles and oftentimes overrides the strongest friendships and most exact informal assurances. When we, as a craft, greatly reduce the number of such occurrences, by being more businesslike and exact in our commitments, perhaps we shall have taken a far-reaching step in solving some of our toughest problems.—*Highway Builder.*

Legal Points for Contractors

These brief abstracts of court decisions in the contracting fields may aid you in avoiding legal difficulties. Local ordinances or state laws may alter the conditions in your community. If in doubt, consult your own lawyer

Edited by A. L. H. Street, Attorney-at-Law

When Failure Substantially to Perform Contract Prevents Recovery

Because it was found that a contractor had failed to substantially perform a contract to convert a house into a garage, the Appellate Division of the New York Supreme Court decided in the case of Jac Building & Construction Company vs. Niccomini, 202 New York Supplement, 132, that he was not entitled to enforce a mechanic's lien. The Court observed that "this failure of substantial compliance prevents plaintiff from recovering anything in this action, since he has not shown the cost of making the proper substitutions, nor any reason for omitting the original requirements."

Effect on Mechanic's Lien—Right of Deviation from Contract Requirements

Holding that not every failure on the part of a contractor to perform a contract requirement defeats his right to enforce a mechanic's lien, the Michigan Supreme Court observed in the case of Benjamin vs. William Hillger Land Company, 196 Northwestern Reporter, 191:

"If bills to foreclose mechanics' liens were maintainable only by contractors who have literally carried out every minor detail of the contract without any deviation, but few could be sustained. Indeed, the statute itself provides that the owner 'shall be entitled to recoup any damages which he may sustain by reason of any failure or omission in the performance of such contract.' . . . Defendant's complaints, it is true, are numerous, but many of them are petty, some defects were rectified, and others were changes made with the consent of defendant's architect. . . . The jury found, and we think properly . . . that defendant was entitled to recoup certain damages; but this does not establish bad faith on the part of plaintiff in filing his claim."

Effect of Clause Against Subletting Work

In a case lately passed upon by the Massachusetts Supreme Judicial Court (Smedley vs. Walden, 141 Northeastern Reporter, 281), questions were raised concerning default on the part of subcontractors on building construction in substituting two-coat for three-coat plaster work, in departing from contract requirements in matching brick and in coloring mortar, etc. The Court said:

"The provision of the contract that there shall be no assignment or subletting of any portion of the work except by permission of the owner in writing manifestly is an important and substantial matter which, at the least, was intended to insure the personal responsibility and the personal supervision of the contractor for and over every portion of the work from its inception to its completion. It is plain this responsibility to be complete must include the intentional defaults and the negligent omissions and commissions of subcontractors and assignees to the same effect and with the same contractual consequence as would follow if the contractor himself had been guilty of intentional departures and negligent omissions or commissions in the performance of the contract or of substantial parts of it."

Time Within Which Mechanic's Lien May Be Filed by Contractor

In the late case of Benjamin vs. William Hillger Land Company, 196 Northwestern Reporter, 191, decided by the Michigan Supreme Court, question was raised as to whether certain work done in constructing a building constituted an independent undertaking which did not extend the time during which a mechanic's lien might be filed on account of erecting the building, or whether it merely involved modification of the main contract, extending the time within which lien might be filed. The Court said on this point, in part:

"There is specific testimony to the following effect: that the plans and specifications required the contractor to place tile outside the walls, that the walls run flush with the lines of defendant's property, and that plaintiff requested of defendant that it procure permission from the adjacent owners for the laying of the tile on their lands, so that he would not be rendered liable for trespassing on their property; that defendant neglected to secure this permission, and the architect told plaintiff the tile need not be put in; that later, when it developed that the basement was damp due to the lack of the tile on the outside, it was arranged that drainage should be put in on the inside of the basement. This was clearly a substitute for the other work, and the last of this work was done on May 6, when plaintiff learned that defendant would not or could not pay plaintiff the balance due. This was not a new contract, but a modification of the old one. The statement was seasonably filed.

Contractor's Right to Interest; Damages for Delay in Completing Work

An Illinois statute authorizing recovery of interest on "all moneys after they become due on any bond . . . or other instrument of writing" authorizes allowance of interest on a construction contract, according to the decision of the United States Circuit Court of Appeals in the case of Wisconsin Bridge & Iron Company vs. Sanford Coal Company, 293 Federal Reporter, 735.

In this case it was decided that, under a contract for the construction of a tipple at a coal mine, the mining company was not entitled to an award of damages based on profits lost through delay by the contractor in completing the work, for want of proper proof that it was a loss fairly within the contemplation of the parties when the contract was entered into. The Court said, in part:

"It cannot be presumed that it was within the contemplation of the parties, when the contract was made, that plaintiff, in case of default, should pay either the rental or use value of the whole of a mining property, or the interest thereon, that evidently, from the character of the equipment, was only to be worked out through the course of many years. While defendant might properly have been permitted, had it offered to do so, to show the value of so much of its land as was actually occupied by the tipple during the time of the default, and might have been allowed interest thereon, as a proper measure of damages, yet there was no such offer."

Maintenance Bond Held to Guarantee Plans and Specifications

An Arkansas highway construction contract contained a clause reciting that the "contractor guarantees all work performed under these plans and specifications for a period of one year. . . . The contractor shall repair any inequalities, settlements, or other unsatisfactory conditions that may occur or develop in any portion of the work performed by him and do all necessary work, and at the end of the specified period shall deliver the work to the district in as good condition as when accepted, ordinary wear and tear excepted, without any additional allowance or compensation." As to certain roads, the guaranty covered a period of five years.

Construing this clause and similar provisions in the contract, the Arkansas Supreme Court said in the case of White Construction Company vs. Arkansas-Louisiana Highway Improvement District, 254 Southwestern Reporter, 820:

"While the question is by no means free from difficulty, we are convinced, after considering the . . . . language of the contract in its entirety, in the light of the situation and circumstances of the parties thereto, that it was the intention of the parties that the work done by the appellants under the plans and specifications and contract at the end of the guaranty period should be delivered to the appellee in as good condition as when the work was completed and accepted by the engineer of the appellee, 'ordinary wear and tear' excepted. In short, it was the intention of the appellee and the appellants that the latter should do the work according to the plans and specifications, and keep the work as thus done in the same condition for five years that it was in when accepted by the appellee, ordinary wear and tear excepted."

"Engineering Work" Defined

In a controversy between the engineer and the contractor employed by an Arkansas road improvement district, the Supreme Court of the state passed on the question as to whether running of levels, setting slope stakes, and inspecting materials was "engineering work" within the terms of a contract, requiring the engineer to do all such work and pay the expense of same, or whether it was work for the benefit of the contractor for which he must pay. (Connelly vs. Parkes, 255 Southwestern Reporter, 22.) It was decided that the expense must be borne by the engineer, although the contractor had agreed to "furnish such reasonable amount of help as the engineer may desire in laying out and measuring the work or inspecting material." Replying to a contention made on the part of the engineer, that the laying out and measuring of the work as it progressed and in inspecting materials before their use constituted no part of the "engineering work" of the district; and that all work done by the engineer of the character above mentioned was solely for the benefit of the contractor, the Court said:

"The specifications expressly provided that the work 'shall be staked or marked out by the engineer. He has supervision over the entire work and his decision as to the quality of both material and construction and the meaning of all drawings and specifications shall be final and conclusive. He has to make monthly estimates of the work done and his decision as to value and quantity of the work and material is final and conclusive. He is to judge of the value and quantity of work and material and his decision as to these is final,' and there is the provision which the foundation of the appellee's [engineer's] claim, to wit:

" 'Engineer's Help.—The contractor shall furnish such reasonable amount of help as the engineer may desire in laying out and measuring the work or inspecting the material.'

"These provisions show clearly that the work which appellee is seeking by his intervention to have the appellant [the contractor] pay for comes under the term, 'engineering work of the district.' Appellee, in his contract with the district, expressly agreed 'to pay all the expense of doing the same,' that is, all the expense of doing the engineering work."

SHOWING THE BULGE IN THE BRICK SURFACE WHICH CALLED ATTENTION TO "SOMETHING WRONG" UNDERNEATH AND CAUSED THE INVESTIGATION

An Interesting Road Failure

Improperly Laid Concrete Foundation Causes Breaking of Brick Pavement

ATTENTION was called recently to several ridges which had developed at intervals in a modern brick pavement in an Ohio county. It was a brick road, just north of Bucyrus, laid not many years ago, and smooth except for these ridges which ran from curb to curb across the pavement. Each ridge was about 2 inches high and not wider than one or two bricks. It was not straight across the road, but took a zigzag or crooked course.

As the filler was asphalt, the defect was puzzling to the engineers of the National Paving Brick Manufacturers Association who studied it. Had the filler been cement grout, which is no longer recommended except where peculiar local conditions make its use advisable, one would have guessed that expansion of the surface had caused a bulge. Had there been

HOW THE BASE LOOKED AFTER THE BRICK SURFACE AND SAND CUSHION HAD BEEN REMOVED

Note the thin overlap of the concrete base

ALMOST NO EXERTION WAS NECESSARY ON THE PICK HANDLE TO PRY UP THE OVERLAPPING SECTION OF THE BASE

Note the complete disintegration of the concrete base and also the curb

only one of these defects, it might have received little consideration, but there were several of them in a single mile.

The state highway maintenance foreman was called on for help and provided men and tools for the investigation. The brick surface was removed at the several places where ridges had appeared, and the sand-bedding course was swept aside, revealing the concrete course. At once the mystery was solved. "Sloppy joints" in the concrete base was the cause of the trouble. In pouring the concrete for the base, it was evident that the day's run was allowed to "peter out" to a thin edge just as the last batch of concrete had been dumped from the mixer. The next day's run started with a correspondingly thin edge pointing in the opposite direction.

During the hot weather of last summer, the base accumulated heat from day to day, getting hotter and hotter, until there was heat enough to cause pronounced expansion. With the "sloppy joint" the expansion could not be held in compression, but permitted one section of the base to slip and crawl up on top of the other. The further it slid up, the more pronounced became the ridge across the surface as the base lifted a course or two of brick. When a pick was inserted under the thin lip, the concrete was found to be disintegrated and was taken out with a shovel like so much crushed stone.

Such failures occurred years ago, but if the road had been built under the National Paving Brick Manufacturers Association specifications, this trouble would not have occurred. Under "concrete base" in the printed specifications, we find the following statement: "At the end of each working period, a bulkhead shall be placed at right angles to the center line of the roadway and perpendicular to the surface of the pavement, to which the concrete base shall be finished (not tapered out). When work is resumed, the bulkhead shall be removed and the exposed face of the concrete wetted before fresh concrete is placed."

Had the concrete base on the Bucyrus road been constructed with such joints, the difficulties described above would never have been experienced.

When Normal Men Are Subnormal

ONE time Frank B. Gilbreth, the industrial engineer, made a study of epileptics. You might say offhand that the knowledge gained by a study of these people would be of no value in industry. But Mr. Gilbreth points out that the absent-minded person behaves for the moment similarly to the motion behavior of most imbeciles and epileptics.

"Motions of epileptics in seizure," he says, "are now known to be largely automaticity of habit formed during periods of consciousness," and he points out that the motions of the normal man not trained to the best way to do work to a point of automaticity are also full of indications and registrations of indecision that are identical with those of the subnormal.

He found out that a bricklayer can be trained to do more than three times as much work with the same effort, and the amateur berry picker may be so trained as to increase his output fifteen-fold.

What we need in this world is less and less talk about shorter hours and higher wages and more and more talk about doing the work that needs to be done in the one best way.

—*The Engineer.*

Manufacturers ---- Distributors ---- Consumers

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Purchasing, Maintenance and Expense Records of Construction Equipment

By R. A. Talbot

Manager, Equipment Department, Fred T. Ley & Company, Inc., General Contractors, Springfield, Mass.

I AM in hearty accord with the cooperative spirit shown by the Associated Equipment Distributors, the contractors and the manufacturers in their joint efforts toward the standardization and stabilizing of the contracting industry as a whole.

From my observation in managing for Fred T. Ley & Company, Inc., over a period of 20 years and from my experience in the field and among other organizations, I would venture an opinion that a large percentage of the contractors who lose money on work or who fail to make money (which is just as important) are those who are without a fixed system and plan by which the job is charged for use of equipment and small tools.

The details that come pointedly under my charge are in the management of the equipment end of our business. As we have been using the rental system (to be described herein) for several years, we feel that it has had a thorough try-out, and its success is shown by the records kept.

In dealing with the rental system that has been developed by the Ley organization, certain basic principles are involved. The first is to see that all new equipment is given a number and that full description—"Ley" number, cost, maker's name, serial and model numbers and name of distributor—are entered on cards for that purpose. This applies only to equipment that is carried on a rental basis and not to small tools. The second is to figure out a fair rental charge for the use of the particular piece of equipment, taking into consideration the following points: average life of the piece in question, in order to arrive at a yearly depreciation; estimated yearly cost of up-keep; interest, insurance, taxes and cost of storage; the total to be divided by the number of days per year that it is expected the particular piece of equipment will be operated.

The Fred T. Ley Company figures absolutely no profit on equipment when submitting a bid for contract work—percentage, cost plus, or any other type of contract, but it does figure that each piece of equipment used has an established value, new or used, and that on whatever work the equipment is used, the contract itself must pay a reasonable rental charge. Such articles of equipment as mixers, hoisting engines, boilers, derricks, also electric and air drills, are actually placed upon the pay-roll under the Ley number at so much per day, and a check for the amount of equipment rental on each job is sent to this department weekly. For this purpose the Ley Company has a printed rental list which is sent to each job undertaken. Rental charges are thus established without guesswork and at a fair, consistent rate. This list becomes invaluable for reference and in establishing proper equipment charges on any type of contract. Each of our jobs is operated independently, all initial steps being taken by the superintendents, who requisition the storeroom through certain forms when and what equipment is needed. This list is immediately set up by my department, and the several units demanded are assembled, loaded and shipped. The rental period of equipment is from bill of lading to bill of lading in accordance with our printed schedule. Therefore, regardless of whether or not a job makes money, the Equipment Department of Fred T. Ley & Company, Inc., receives payment for the use of its equipment. The weekly "equipment invoice reports" received from jobs are carefully checked and entered in a special Earnings and Expense book, designed by us, and all expense is entered against the income, so that we can tell each year our net income on each piece. Each year's records are then entered in a ten-year book, from which future data may be derived. The expense items charged against the income consist of overhauling, maintenance and a fixed depreciation charge, interest, taxes, insurance, etc.; thus a perpetual record of each piece of equipment is maintained at all times and can instantly be referred to as an authentic record of the machine's past performance and the number of jobs it has been on. We are thus vindicated many times for paying a trifle more for a better grade of equipment with a lower maintenance cost, as against a cheaper product usually having a higher labor and maintenance cost and shorter life.

All rentals are based on a six-day week. Holidays and Sundays are charged for if the machinery is employed. Inasmuch as our work

embraces a tremendous field, from high-tension power lines to industrial construction and large office buildings, factories, etc., it is at times difficult to average the proper rentals of certain equipment which on one job might be idle a great portion of the time and at others continually in use; still, I believe we have satisfactorily covered this point by our prearranged fixed charges, as explained herein.

Every piece of equipment has an average life, whether continuously or intermittently used. This is fairly determined by reasoning and experience. Under this system, the cost of this equipment should be charged off completely within this fixed period. All small tools, as well as large equipment, are identified by a small brass name-plate bearing our name. If they are too small to attach a name plate to them, we stamp on "Ley" with steel dies or brand them. Thus, no part of the Ley equipment is without a means of identification.

Fixing or establishing rental values is not necessarily accomplished by the assumption that the purchase price should be a determining factor. It is not the actual value of the unit used, but the value of the work accomplished. The elimination of labor in a large measure determines this rental value of equipment. Apropos to this statement is an instance of many special pieces of equipment absolutely required to accomplish a certain specific duty, that probably will only be used once or twice a year. The rental value on this class of equipment would naturally be higher in proportion to that of a unit that is continually in service and is income-bearing. It is a regrettable fact, but nevertheless fairly well established to-day, that a great many contractors ignore their equipment overhead, assuming that they have the equipment to use, bid on the job, and take a presumable profit without having charged off against equipment a depreciation value and a fair rental value and setting up a reserve.

The question might occur to a reader as to the rental price of new versus old machinery. That question may be answered by saying that this point is immaterial if the work performed is equal in both cases. In other words, I refer to the value of the work performed as illustrated by the necessity for a trip through a city in a taxicab. If you reach a given point in time to catch a train, whether you are riding in a new taxicab or an old taxicab, the value of the trip and the results given are equal and you are willing to pay the driver the same charge for the use of a five-year-old cab as though he took you in a new one.

There are many other details embodied in this system which emphasize the importance of careful handling and recording the transfer of equipment from job to job, and the importance of keeping the equipment department informed of any equipment that a job expects to release, so that it can be placed on another job; this will enable the equipment department to keep the equipment working and to do a maximum amount of work with a minimum amount of equipment.

When a job is through with its equipment and small tools, they are returned to our Springfield storehouse, where all equipment and tools are thoroughly overhauled, cleaned and repaired and made ready for the next job. We are maintaining a complete repair shop, machine shop, carpenter shop and storerooms, so that when a new job is started, the equipment is in condition to do efficient work without the job's having to overhaul its equipment before putting it to work, as is done by some contractors.

As regards small tools, such as shovels, picks, bars, wheelbarrows, axes, rope, blocks, concrete carts, etc., the policy of this company is to make a charge against the job for the use of such tools on the basis of a percentage of the pay-roll. We use a "tool sheet" for each job, on which are entered all tools sent from our storehouse, also all tools sent from another contract, as well as any tools bought locally. (The bulk of the tools are bought in large quantities in order to get the best prices; they are stored and furnished on the superintendent's orders from the Springfield storehouse, and he is not expected to buy tools in the field except in cases of emergency.) When tools are sent to another job or returned to the storehouse, they are credited to the "tool sheet," and our loss and depreciation in dollars and cents on each job can be readily determined.

We are also able in this way to determine the percentage of tools lost or unaccounted for and know which of the job superintendents take the best care of their tools.

A fixed percentage of the pay-roll for the use of small tools on different types of jobs is a great help in estimating new work. While there is a difference in the cost of small tools for a building job as compared with a dam job or a road job, from records that we have kept we are able to determine the average and arrive at a percentage of the pay-roll which is used on all types of work, whether contract, percentage or cost plus.

This arrangement when used on cost plus or percentage work is attractive to the client, as he is not bothered with approving bills for tools, which many times they (the clients) think unnecessary, and there is not the trouble of the contractor's settling with the client over the tools left at the completion of the job.

Standardization in purchases is always an asset. However, standardization, like anything else, can be carried too far. We believe in the established and responsible machinery equipment distributor, and his service to the industry, and it would be unfair to deny that he has played a large part in the life of every contractor in bringing before him ways and means of saving money by the acquisition of the proper machinery, and facts of design and construction that have simplified the purchase and reduced it to a point where risks are negligible. In spite of our maintaining a complete repair shop of our own, our work, scattered all over the United States and abroad, requires constant recourse to established distributors' service departments as auxiliaries to our own shops at Springfield.

General Contractors' and Builders' Equipment at Work

FIVE 2½-TON MODEL 78 GARFORD TRUCKS USED BY THE HYDE PARK TRAP ROCK COMPANY, INC., BOSTON, MASS., FOR HANDLING CRUSHED STONE FOR ROADS AND CONCRETE AGGREGATE

A CONCRETE MIXER USED FOR MIXING BRICK MORTAR ON THE ST. MARY'S HOSPITAL JOB, ST. LOUIS, MO.

This 4-S Smith tilting mixer was used by Charles H. Kuhlmann, a brick contractor, with thorough satisfaction. The mixer was sold to the contractor by the George F. Smith Company, St. Louis, Mo.

Apprenticeship in the Building Trades

A Symposium as Applied Particularly to Conditions in Boston

IN introducing this subject before the Boston Society of Civil Engineers, as recorded in the *Journal* of the Society for November, 1923, Colonel Frank M. Gunby, a representative of the Boston Building Congress on the Apprenticeship Commission, stated that there are one or two fundamental differences between the system now being tried and the old condition. The first difference is that the apprentice under the new system is apprenticed to his craft and not to the individual employer. Second, the system is to be operated both by the employer and the employee group, and it is hoped that it is going to continue as happily and as enthusiastically as when the start was made.

William Stanley Parker, President of the Boston Building Congress, brought out very forcefully the reasons for the failure of the older systems. In the past when an apprentice became indentured to an individual employer, his security of employment depended solely upon the ability of that employer to keep him employed and also to vary his work, so that he should have not only steady employment but an all-round training. With the fluctuation in work that exists to-day among the larger contractors, they are having increasing difficulty in keeping any material number of apprentices, even if they existed, in steady employment. This is one of the things that make it difficult for the contractor to assume any large number of apprentices, and it is a difficulty of the individualistic system. If the contractor hasn't a sufficient amount of work, either the apprentice is kept at work of not much benefit to him or else he loses his job and has to find other employment. That system, with the present fluctuation in employment, is satisfactory neither to the contractor nor to the apprentice, and leads contractors to cease taking on apprentices.

Another situation which has been serious in the past is that during times of peak loads in the labor demand in the building trade apprentices or half-baked journeymen have been lured into positions of greater responsibility than they are equipped to assume, and yet you can't blame them for going to some outlying district where they knew there was a demand and where they could get a journeyman's wage and "get away with it." In the past this has led many an apprentice to break his apprenticeship in order to make a little quicker headway. After a relatively short time he would, perhaps, come back and approach his former employer for work as a full-fledged mechanic, technically speaking, but not technically trained. This did not please the employer, who had borne the expenses involved in carrying the apprentice in his early days and then was not permitted to derive the benefits from his employment in the later years of his apprenticeship. That is another of the important reasons why contractors have turned against taking on apprentices in recent years.

The Apprenticeship Commission of the Boston Building Congress had its first meeting in March, 1923. The Commission, which is broadly representative of the industry, includes three men appointed by the labor group, three by the contractor and subcontractor group, and three by the Building Congress from those representing other elements than the contractor and the labor group. A method of procedure was laid out, and an outline of certain fundamentals that control the situation was drafted and presented to all the crafts. Some seven or eight crafts have been in joint-committee deliberation upon these rules, and two of the crafts—the carpenters and the bricklayers—have agreed definitely to adopt the system.

The A. G. C. Resolution on Apprenticeships

WHEREAS, there is existing an ever-increasing shortage of skilled building mechanics throughout the country; and

WHEREAS, no relief from this condition appears possible except by the development of proficient mechanics by the construction industry itself:

NOW THEREFORE BE IT RESOLVED, that the Associated General Contractors of America cooperate with the American Construction Council, educational institutions and local associations in the establishment of apprenticeships and in the actual training of apprentices.

The most important fundamental of the system is the indenture of the apprentice to his craft. The apprentice makes his application to the Joint Apprenticeship Committee of his craft, and when he is taken on he signs on with this committee. He signs a statement that he has read the system of apprenticeship adopted by the craft and agrees to abide by it and all the rules of the Joint Apprenticeship Committee. If he tries to double-cross his craft, he will find it much more difficult than it has been in the past to double-cross an individual employer, and he will also have a much greater chance of steady employment, because one of the fundamental duties of the craft Joint Apprenticeship Committee is to keep him steadily employed during his apprenticeship period—three or four years, as the case may be in that particular craft. Instead of being dependent on the individual employer, he has the Committee

back of him, and if his employer is for the moment slack, the Committee must take him and put him with some other employer who is busy. Wth a normal amount of business, the apprentices will be taken care of all through their apprenticeship period if the Committee can in this way shift them about. This shifting can be done by the Committee not only for the purpose of giving steady employment, but also for the purpose of giving all-round training. It is not easy to pick many employers who can take on a large number of apprentices and give them all the necessary elements of their trade. They are apt to concentrate more or less on one kind of work, and it will undoubtedly be necessary to shift the apprentice frequently for his own interests and the interests of the trade. That power the Joint Apprenticeship Committee has, and it must keep a record of the apprentices and see that by the end of their apprenticeship they have secured sufficient and thorough training in all the different elements of their craft.

George Thornton, Second Vice-President of the Bricklayers, Masons and Plasterers' International Union of America, spoke on the difficulties encountered in these trades through seasonal unemployment and also the misunderstanding of the apprentice problem by the public. In Boston there are about 80 apprentices indentured in the bricklaying trade. Thirty-nine of these apprentices are indentured to contractors, and the remainder are indentured to their fathers. The fathers did this because the boys could not be placed with contractors. There are no restrictions placed on apprentices either by the International Union of Bricklayers, Masons and Plasterers or by the local unions in Boston. The local unions prescribe certain laws for the government of apprentices. One condition is that the apprentice must be at least 16 years of age and know how to read and write the English language, and that a boy taken under the age of 18 shall serve until 21. A boy taken over the age of 18 shall serve three years. A contractor is permitted to take three apprentices. The Bricklayers, Masons and Plasterers Union in Boston deals with over 100 contractors, and if these contractors took their full quota of apprentices, there would be a number far in excess of the number now registered in the city. Mr. Thornton states that unless a boy is continuously employed for three years by a contractor, and given every opportunity to learn all branches of the trade of masonry with all the short cuts in connection with the brick-laying trade, he will not be a full-fledged mechanic. The Union wants not only to see a journeyman fully qualified to demand a standard scale of wages, but to see him learn the technical part of the trade. It wants to see him, when he has completed his work in apprenticeship, qualified and able to take charge of work.

Major Heywood S. French, representing the Building Trades Employers' Association on the Apprenticeship Commission, stated that in normal times the larger part of the construction work in Boston is carried on by members of the Association, but whenever the building industry becomes of a highly speculative nature, as has been the case during the last few years, they are not in charge of the greater part of the work. It has been estimated that during the last two years 65 per cent of the men in the carpenter and mason trade have been working for those who have had little previous connection with building and who are not concerned with establishing or maintaining sound and stable conditions in the industry. The members of the Association, however, realize that this is but a temporary condition, and that it is more necessary than ever before in the history of the country to assure a supply of well-equipped, thoroughly trained, self-respecting American mechanics in the building trade.

Not only is this necessary, to provide the skilled men for the different undertakings, but from their ranks must come the men who are permanently employed by the leading firms and available at short notice for responsible work, and also the sub-foremen and the foremen and the superintendents of the large firms and the smaller individual contractors. The possibilities of advancing in this line of work compare most favorably with those in almost any other line. Rapid advancement is practically assured to any young man who is diligent and anxious to learn; who will convince himself that the way to advance is to work hard, and that his employer's interests are his interests; who will try to do a little more than he could be forced to do by the strict interpretation of his employment agreement, and for three years at least will devote all of his spare time to acquiring all possible efficiency and experience in his chosen calling. It is the hope of the employer that a young man taking the opportunity of enrolling under the present system will be afforded an opportunity to develop into the kind of workman that will maintain the traditions of the best mechanics.

It may be thought by many that the interest of the employer in this or any similar movement is a purely selfish one, that he is concerned solely in trying to have provided the greatest possible number of workmen with only such a training as will enable them to "get by" in order that they may be more completely and easily controlled.

Mr. French emphatically stated that his association is working to provide for bringing into the ranks of his particular branch of construction the bright, skillful, hardy young man who wants to become not only a workman proficient in his particular line but one who will have a good general knowledge of the related trades; one who will be able to look with pride on the particular work which he has personally performed on any structure; one who aims to become a person of consequence in his community, and who looks forward to the day when he will be called to greater responsibility in his chosen vocation; one who will do his own thinking and is willing to assume his full share of responsibility for his act. The contractors are backing this program with these objects in view, and hope that in years to come the men produced under this system, when associated with the men who will come into the industry

with a thorough technical education and training, will maintain it upon the high plane which it has occupied.

In many respects the adopted method of handling apprentices differs from the older ways. It was formerly possible for a young man to start with one firm and get a thorough understanding of all the problems to be met in his trade, but at the present time there are very few organizations which carry on such a diversity of work that they can give the apprentice the necessary training to make him an all-round man who can fit into any place and satisfactorily perform his part. It is for this reason that the men will be apprenticed to trade committees and will be generally under the supervision of the Apprenticeship Commission. This enables the apprentice not only to acquire experience in all details of the trade but to perfect himself in some particular line which specially appeals to him. With representatives of his future employers upon the Committees which are supervising his work and giving the benefit of their experience, a great step has been taken to provide for the future supply of men skilled in the various crafts.

This system insures that those desiring to enter a trade shall acquire a thorough training in that particular trade. The question arises as to whether the number desiring to learn any particular trade will be sufficient to maintain the system. At the present time it is not easy to interest people in lines that promise a period of hard and often disagreeable work, when there are apparently so many others that promise liberal returns for very little effort. That difficulty will soon be met, however, for many people are now envying the skilled mechanic, not only on account of his financial returns, but also on account of his independence. It has been said that many have been deterred from learning a trade on account of the restrictions of the unions as to membership. While there may be cases of oppression on the part of some of the unions along this line, any man who becomes skillful in any trade will have an opportunity of earning his living at that trade.

James M. Gauld, Secretary, Massachusetts State Council, United Brotherhood of Carpenters and Joiners of America, recalled that the carpenters tried to put in an apprentice system without cooperation from anybody. Their constitution embodied everything which the Apprenticeship Commission in Boston is putting into effect, but after getting a few boys into the industry, it was found that there was no cooperation from the employers. The reason for the failure of their efforts was the fact that there was no disinterested faction to stand between the labor union and the employer, with the result that when a change was asked in working conditions, war was declared and the apprentice invariably lost. Under the new plan this will not be permitted, for there will always be the Building Congress to keep the contract, assuming that the other two elements are not silly enough to have any further disturbances. Mr. Gauld called attention to the fact that there will be considerable expense in putting through the program of the Apprenticeship Commission, but he stated that labor will be glad to contribute its share in the near future and that the employers have already done so.

1924 Marks Centennial of Cement Industry

OLD records on file in the British Patent Office show that in 1824—just one hundred years ago—an English bricklayer named Joseph Aspdin was awarded a patent for a material he called "portland cement." At that time a number of men were engaged in experiments in an effort to produce a cement superior to the natural cements then in use. As far back as 1756 an English contractor named John Smeaton had discovered that an impure limestone containing a certain amount of clayey matter possessed decided hydraulic properties when burned. Aspdin's contribution was his discovery of the value of taking proper proportions of different ingredients and then pulverizing and thoroughly mixing them before they were burned into clinker, which later was finely ground. He called his material "portland" cement because when it hardened it resembled a building stone quarried on the Isle of Portland.

Although Aspdin's invention was brought out in 1824, it was not until 1872 that the portland cement industry started in the United States. Of course natural cements had been used here for years, and in the late sixties imported portland cement was gaining a strong foothold in the American market. In 1872 David O. Saylor established a plant for the manufacture of portland cement at Coplay, Pa., and so far as can be ascertained this is the first plant of its kind to be started in this country. Within a few years other plants were built at South Bend, Ind., Kalamazoo, Mich., and various parts of the East.

Many interesting stories are told in connection with the early efforts to produce portland cement in the United States. One man used a cookstove in which to burn rock while conducting his experiments. Another used a piece of sewer pipe as a kiln, and ground his material in a coffee-mill. Still another pressed a bent car-axle into service as a part of a grinding machine. For a number of years the reputation of imported cements was so strong that American manufacturers had a difficult time in securing a market for their product. It was not until the late nineties that the home product took its place on an equal footing with imported cement, and eventually won the market.

One hundred years after the invention of the material, the plants of the United States are producing more portland cement than the rest of the world combined. United States Geological Survey figures indicate that about 135,000,000 barrels were made in 1923.

This development has necessitated the revolutionizing of methods of manufacture from the old crude dome-like kilns to the new rotary kilns.

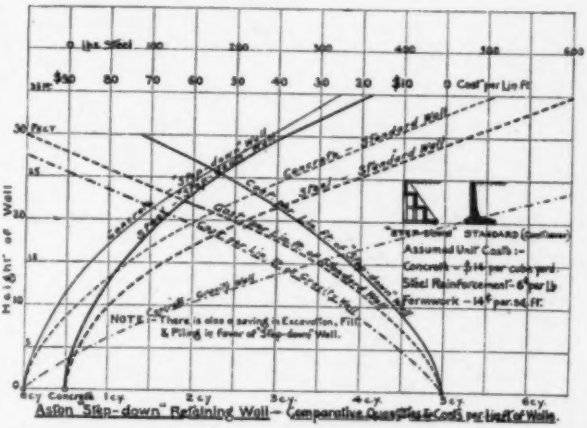
The New "Step-Wall" System for Bulkhead Construction

By Taggart Aston
Consulting Engineer, Portland, Ore.

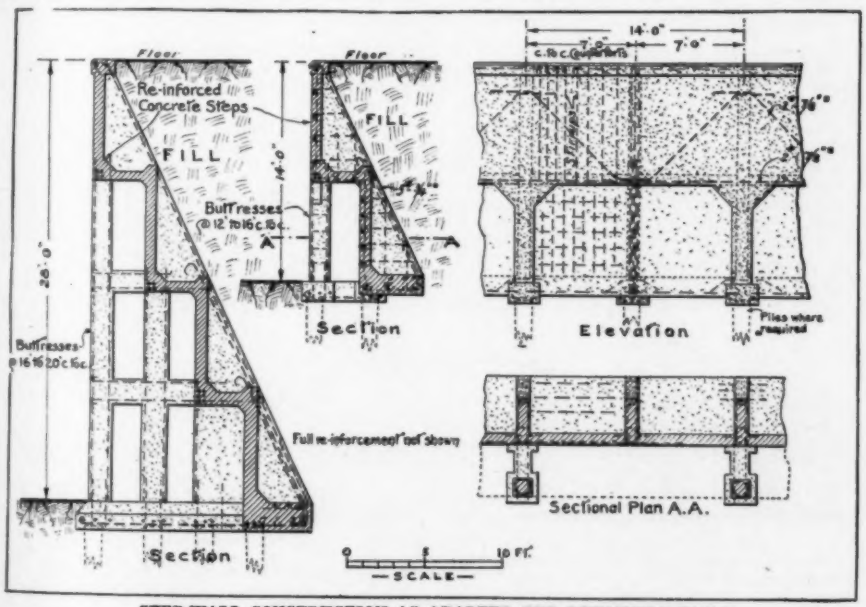
ENGINEERS familiar with the high cost of existing standard types of bulkheads for retaining walls, wharves, bridge abutments and dam walls have been seeking new forms of reinforced concrete construction that might be cheaper and more stable. A hollow step-down concrete wall system for the construction of such structures has recently been developed which is a radical departure from standard types of construction. Judging from many comparative designs and from work already constructed, it is felt that this type is probably the cheapest and most stable form of reinforced concrete bulkhead construction.

There is a great economy in this type of construction, as the series of small step-down retaining walls, supported on columns or bents, contain much smaller quantities of steel and concrete than the standard gravity, cantilever or counterforted walls of the same heights. In step-walls there is also a saving in the amounts of fill, excavation and piling.

This type of wall has increased stability, as



COMPARATIVE COSTS OF STEP-WALLS, CANTILEVER WALLS AND GRAVITY WALLS PER LINEAR FOOT



STEP-WALL CONSTRUCTION AS ADAPTED FOR RETAINING WALL

the small counterforted retaining walls are stepped back and downward, eliminating a large wedge of weight existent in standard walls in fill and concrete from the front of the wall, thus throwing the resultant overturning force farther back in the case of the step-wall than in the standard wall. This makes the new type more stable for the same width and height of wall. The elimination of this large excess weight also materially reduces the amount of piling and underpinning required.

By using precast steps, bents and columns for wharves subject to the rise and fall of tides, the difficulty of molding the concrete in place can be overcome except at joints. Ordinary retaining walls of moderate height can also be precast in short lengths, using standardized metal forms at a considerable reduction in cost. The weight of a 10-foot wall 12 feet in length should not exceed 7 tons. The foundation would preferably be molded in place. Contractors in large cities will find it of advantage to possess a set of standard metal forms and to put in alternative bids for step-walls where engineers have planned standard types. They would thus largely increase their own profits and at the same time be able to save money for the principals. It is advisable, however, that details for step-walls should be made by expert reinforced concrete engineers in order to secure the highest safety factor compatible with the greatest economy.

Several step-wall wharves have recently been designed for ports in Canada, Europe and the United States. In the mail steamer pier recently designed for Queenstown, Ireland, the step-wall design was recommended, as it was estimated by the engineers that it would save about $600,000 over the cost ot standard types of wharves. It has been estimated that it would cost less than a wharf built wholly of timber in some situations, and it is the only type of permanent, fire-proof wharf wall that competes with a timber wharf in low cost. John Kenlon, Chief of the New York Fire Department, has stated in his book on "Fires and Fire Fighting" that "the sheds or wharves common to America form about the most dangerous structures of their kind in existence. Built on wooden piers with wooden superstructures, they are comparable to nothing but horizontal flues through which the flames rush with lightning-like rapidity, rendering abortive any efforts on the part of the fire department." The advent of the economically adapted step-wall wharf should therefore be given due consideration by port authorities as a desirable substitute for the temporary wooden wharf structures now so generally used.

Comparative Costs

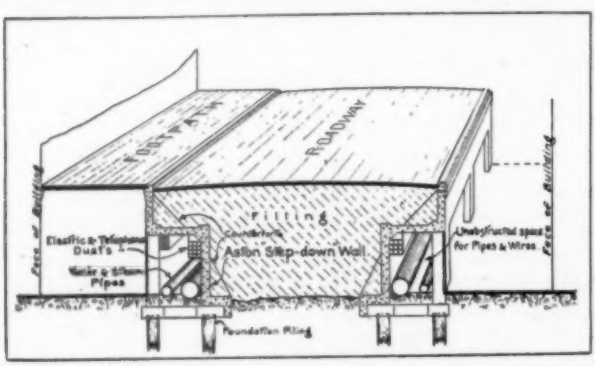
Probably the most expensive type among standard retaining walls is the reinforced concrete cellular or webbed wall. Next in order are gravity, counterforted, cantilever and crib walls. The average comparative differences in cost for a wall 21 feet in height are $68, $62, $54, $51 and $46, respectively. The step-wall costs about $38 per linear foot, making it the least costly type of wall to suit almost every situation.

The accompanying diagram showing the curves of cost for various types of wall indicates clearly the comparative quantities and costs of walls from 4 to 35 feet in height. In a 21-foot step-wall recently built in Oregon, the quantities show a saving of $15.50 per linear foot under the cost of the cheapest form of standard wall.

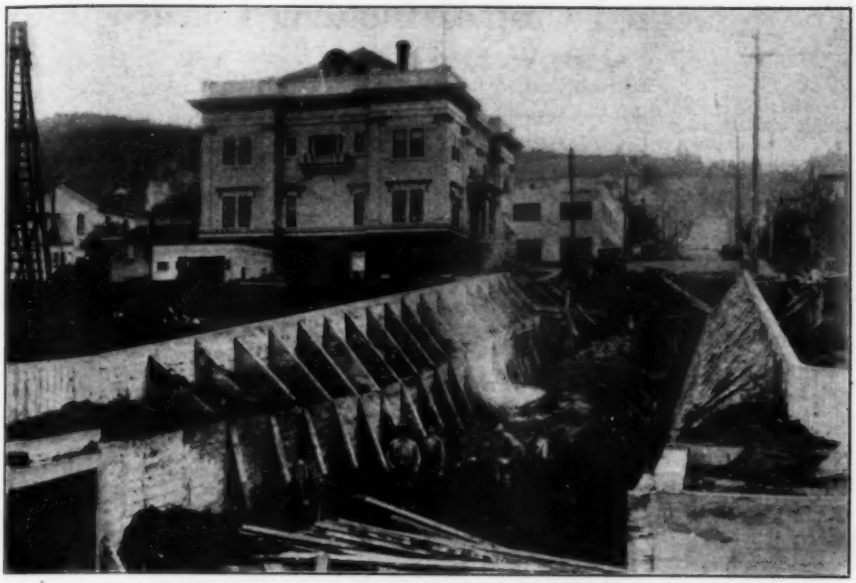
Step-Wall Construction in Astoria

An interesting example of step-wall construction was recently completed in Astoria, Ore. In December, 1922, a fire destroyed the main business district where the streets had been carried on timber trestles, surfaced with asphalt, the street surface being some 12 feet above the sand fill which had originally been pumped from the Columbia River. These streets were completely burned to the ground.

In considering a new type of structure, the city officials favored concrete viaducts under which water-mains and electrical wires could be placed and made readily accessible for repairs. This form of construction was, however, rejected on account of its excessive cost, and alternate bids were called for cantilever retaining walls where pipes and wires would have to be placed in the filling between the walls, and a modified form of step-wall where the upper step was made sufficiently wide to accommodate under it the water-mains and other utilities, except sewers and gas-mains. The City Manager, in his report to the City Council upon the receipt of the contractors' bids, said, "The advantage of the step-down wall over the cantilever type is very apparent under our present conditions. First, it is a



THE ASTON STEP-DOWN BULKHEAD SYSTEM, ADOPTED BY THE CITY OF ASTORIA, ORE.



BUILDING THE STEP-WALL IN ASTORIA, AFTER THE BIG FIRE
In handling this work the mixer had a special rigging which permitted it to pour on both sides from one setting

more stable wall; second, it forms an underground tunnel in which to house public utility wires and pipe without encroaching on private property pending the widening of the streets, and in cases where property has already been deeded for the extra width of the street, it gives the full space under the sidewalk to the abutting property owner for private use. Third, it is the least expensive kind of wall to build."

The City Council adopted the step-wall, of which some 10,000 linear feet of reinforced concrete retaining walls have now been built in Astoria. These are mainly 13 feet in height. The following table shows the comparative quantities in the two types of wall, the step-wall and a standard cantilever wall, which were bid upon for this height, the figures being per linear foot of wall:

Step-Wall	Standard (Cantilever) Wall
0.17 cu. yds. excavation in foundations	0.50 cu. yds. excavation in foundations
0.545 cu. yds. concrete	0.81 cu. yards concrete
49 pounds steel reinforcement	59 pounds steel reinforcement
34 square feet formwork	28 square feet formwork
5.88 linear feet of piling	7.51 linear feet of piling

These quantities are slightly greater than for an ordinary step-wall, as a wider step than was necessary for bulkheading purposes was used in order to provide a space for public utilities. The contract price for the 13-foot wall was $17.10 per linear foot.

R. A. McClanathan, City Engineer, was in charge of the work, assisted by R. H. Furrow. John Slotte & Company were the contractors. The preliminary designs were furnished by the Aston Step Wall Company, 149½ Twenty-First Street, North, Portland, Ore.

Justifiable Pride

A contractor, who was as square as a brick—
As many good contractors are—
Was "laid by the heels." He was grievously sick
And was just about crossing the bar.
His friends were all gathered just outside the gates,
Ere he entered upon the long rest;
They asked him which of his many good traits
He really considered the best.

He gazed on the faces surrounding him there,
His look was of one unafraid.
He murmured, "I've always tried hard to be fair,
And when under the sod I am laid,
There is one thing I want you to put on my stone
So the fact may never be hid.
Let the words be deep graven and stand out alone:
'He Never Peddled a Bid.'"

—F. N. Farrar in A. G. C. News-Letter.

The Increased Cost of Building Construction

By W. Fred Dolke, Jr.
Lockwood, Greene & Company, Engineers, Chicago, Ill.

Do You Agree?

Here is an article on a subject which interests every man with a building problem. As you read it, remember that this is the expression of opinion of one man only. Some people will not agree with Mr. Dolke, others will. We are reprinting this statement from The Engineer, published by Lockwood, Greene & Company, to stir up more interest in this particular subject.

THE usual type of cost data, based on comparisons of the present cost of building materials and labor with the pre-war costs of materials and labor of the same quality, indicates that an industrial building to-day is about twice as expensive as it would have been before 1914. When we compare present unit costs with actual unit costs of the earlier date, however, we find in a great many instances that the increase is more than twice. Why is this?

It seems to me that the answer lies in the fact that more expensive types of building materials and equipment are being used to-day as common practice.

Quite properly more attention is being given to-day to better architectural treatment of industrial plants. Beautification is realized most effectively through the proper grouping of the architectural elements of the building to obtain a pleasing composition, and the materials used for the exterior faces of buildings are to-day more expensive.

Face brick is now the usual material where once it was considered an unnecessary luxury. Ornamental terra cotta and cut stone are being used more and more for local emphasis. The tower is now a common feature of an industrial building. The economic and social value of a good architectural treatment of a factory exterior is recognized by all modern industrial executives, and the additional cost, kept within reasonable limits, is well justified.

Similarly, better equipment is being used. The individual lavatory has replaced the old plain iron sink. Hot water and liquid soap are more frequently supplied. Enameled steel toilet partitions have replaced the unsanitary wood partitions.

Terrazza floors in toilet rooms are more common. First aid rooms, rest rooms, locker rooms, and similar facilities for employees are now provided as common practice.

Artificial illumination is better. Not only are larger lamps being used, necessitating larger wires and conduits, but more expensive and more effective types of reflectors are being provided. Extra circuits for night and emergency lighting, for signal systems, and for telephones are now part of standard building equipment.

In the field of heating not only are vacuum systems more common, but the automatic temperature control system is being more frequently installed. Artificial ventilation is now a legal requirement in some localities for certain conditions and is more commonly provided in the average factory.

Elevators are larger and travel at a higher rate of speed. Many of them are properly equipped with self-leveling devices and with self-opening doors.

Many other items could be mentioned. All of them have economic value. In addition, where more expensive equipment or materials are now used it is largely because the ultimate cost per year of service is less or a decreased operating cost is experienced. Nevertheless, the original or first cost is more than formerly experienced for a similar type of building.

Factory owners have been educated so gradually to better architectural treatment, to better materials and equipment, that they do not realize the extent to which the first cost of a plant has been increased by including therein materials and types of equipment which ten years ago they would have called luxuries.

Building Codes and You

WHEN a building code is wrong or misshapen, it is a cripple burdening the work of contractors. Therefore if there is bungling or worse in the building code of your own city, the duty comes to roost right on your own shoulder to change the code. Pretty big order, you say.

Yes, it is a fairly tedious task, and it requires the playing of politics in many cases. It is possibly harder to change a code than to make it right in the beginning. But when the hard fact stares us in the face that a code was not made right in the beginning, the changing of it is the only way out of the difficulty.

A code which falsely restricts the use of any legitimate material makes the contractor's lot harder. It does this in two ways: first, it limits him in his own province of selection: second, it makes the prospective builder peevish and hard to deal with.

The work done by the Department of Commerce of the United States in drafting a basic building code is an excellent departure and deserves full support. But, more than that, the contractor must himself start the ball rolling and prosecute the battle for equitable building codes in his own city.—*The American Contractor.*

VIEW OF JONES ISLAND SEWAGE PLANT IN COURSE OF CONSTRUCTION

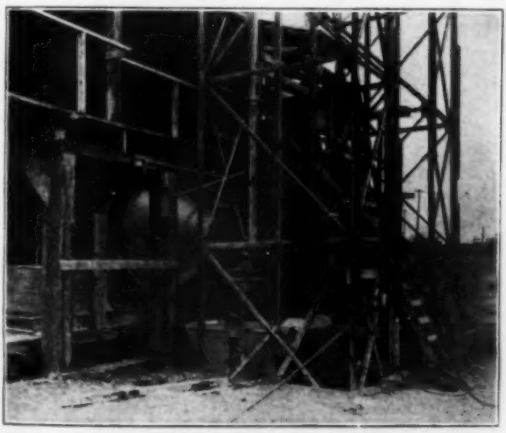
Concrete Work on the Jones Island Sewage Plant, Milwaukee, Wis.

Concrete Plant Layout and Organization Well Planned for Handling the Work

WORK on the sewage disposal plant at Jones Island, Milwaukee, which will cost well over three-quarters of a million dollars, is being pushed rapidly for completion before the end of this year. It is expected that the job will require a total of 64,000 yards of concrete.

The mixing equipment on this job, which is producing an average of 400 yards a day, consists of two electrically-driven Smith 40-S concrete tilting mixers, each with a capacity of 1½ yards. They are equipped with batch hoppers, water-tank and batch meter and are situated as the central units in the large mixing plant on the long sides of the job. Extending in radial lines from this central mixing plant, chutes carry the concrete to all parts of the work. The outside dimensions of the job are 650 x 750 feet, with the highest point of concrete ranging 20 feet, which gives some idea of the extent of the work. In addition to the mixers, the central mixing plant includes two Insley steel hoisting towers of 1½ yards capacity, 216 feet high, so arranged that power is supplied to both hoists by one 100-horsepower double-drum Thomas electric hoist.

Aggregate for the concrete is put into the mixers from two overhead bins, each of about 100 yards capacity. These bins are fed by two 100-yard-per-hour capacity chain bucket elevators, which, in turn, are fed by automatic chain-driven feeders, all of this apparatus being electrically driven. When available, bottom-dump cars deliver the sand and gravel to the bottom of the bin. When other cars are used, a 1-yard clam-shell derrick unloads the cars. This derrick is also being used to handle the material for the 1,000-yard stock pile which is maintained.



TWO ELECTRICALLY DRIVEN 28-S SMITH MIXERS COMPOSE THE CENTRAL MIXING PLANT WHICH FEEDS THIS ENTIRE JOB

A cement bin of about two cars capacity is located close to the bins for emergency storage only. A gravity trolley system with cement containers of the bottom-dump type, each of about 8 bags capacity, is constantly carrying the cement to the mixers from the cement cars as they arrive.

From the mixing plant the concrete is conveyed to the various parts of the job by a series of hoisting towers and several lines of chutes. Two main towers at the mixing plant supply one line of chutes 450 feet long to an Insley rehoist tower 196 feet high. This rehoist tower in turn supplies a 120-

foot tower placed in the center of the job, which supports a line of chutes 280 feet on each side of the tower with a 50-foot counterweight chute on each end, which is used to pour the circular tanks located in the center of the construction work.

An Insley guy derrick of 10 tons capacity, with a 115-foot mast and a 100-foot boom which supports the double counterweight chute system for a total operating radius of 170 feet, is being placed in four different working setups and is supplied with concrete, either direct from the main hoist towers or from the rehoist tower. Williamsport cable is used throughout the job, the main suspension cable being 1½ inches in diameter and the remainder being 1¼ or 1¼ inches. The concrete mixers are being operated alternately, and the specifications call for a 1½-minute mix. They have reached a maximum of 600 yards per day in one continuous pouring. The average day, however, produces about 400 cubic yards.

Handling Material with a Cableway Dragline Bucket

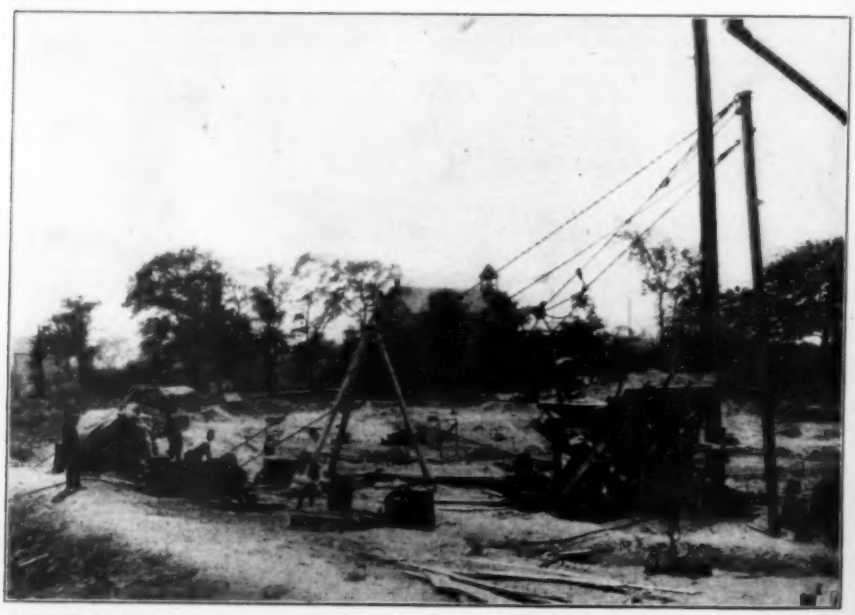
Building the Swimming Pool at Dreamland Park, Newark, N. J.

THE swimming pool at Dreamland Park, Newark, N. J., is one of the largest and best of its kind in America, being really a fair-sized lake with a concrete bottom and banks. The concrete work on this pool was done by A. L. Trimpi, Chatham, N. J.

The contractor's plant consisted of a mast chuting plant, material measuring bin, a power concrete mixer and a cableway dragline excavator, all operated by gasoline engines. Crushed stone and sand for the work were hauled in the winter and stored in piles on the site.

The mast was located so that the chutes would convey the concrete to forms on a third of the job, thus making necessary only three set-ups on the entire job. The mixer discharged the concrete directly into the mast bucket and, in turn, received the charge of materials directly from the material bin without rehandling. The piled-up material was placed in the material bin at a very low cost, utilizing the cableway dragline method illustrated below. A Domestic double-drum hoist with a 9-horse-power single-cylinder engine was used to operate this outfit and was found ample in power to dig through the piles of crushed stone and bring a full bucket of material to the bin on every haul. Two men were used in handling the materials—one on the hoist and another on the bin taking care of that end of the job.

The same system is becoming popular with many excavating contractors doing cellar work, as well as with contractors and owners of sand and gravel pits. The low cost per cubic yard of material handled, the moderate investment and the ease of operation make this method worthy of more general adoption.



LAYOUT OF THE A. L. TRIMPI SWIMMING POOL JOB AT DREAMLAND PARK, NEWARK, N. J.

Building Conditions in the United States

Prepared by S. W. Straus & Company

Promise of Active Spring Season

FEBRUARY building permits throughout the United States indicated a continuation during the immediate future, barring unforeseen developments, of new high records in construction. It is always to be borne in mind in analyzing data of this nature that building permits offer the most accurate index of approaching conditions. They are straws which show which way the wind is blowing.

The February exhibit herewith presented, showing reports from 329 cities and towns throughout all sections of the United States, therefore presages the most active spring building season in the history of the country, except, of course, in case of unexpected eventualities within the next few weeks. In the 314 cities and towns in which comparisons are available there was a gain during February of 20 per cent over February last year.

The Eastern group of cities gained 38 per cent; the South gained 9 per cent; the Middle West lost 5 per cent; and the Pacific Coast group gained 14 per cent.

Study of the reports reveals that a considerable part of the nation's building activities is concentrated in the larger cities. The 25 centers which led in building permits for the month reported $221,659,653, or 75 per cent of the entire list.

Building-Material Situation

Building-material prices increased somewhat in practically all lines during February. In the East, especially in New York City, the rise in starting materials was significant. Southern pine was somewhat scarcer than usual, and as a result prices were higher, but they were still considerably below February of last year. Cement and lime prices in some Middle Western cities were softer. Structural materials, rivets and bar iron also showed slight decline. Among building-material experts the immediate expectation was for further increases in the spring months.

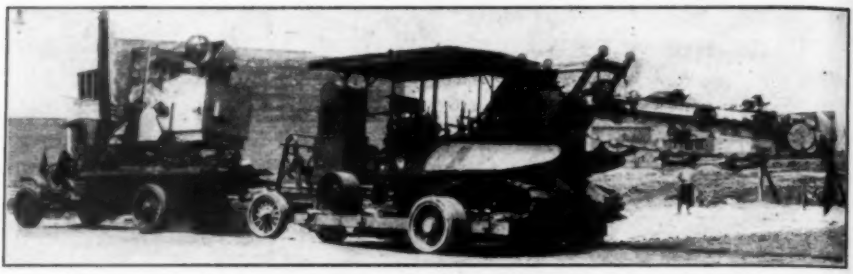
SUMMARY OF FEBRUARY REPORT, BY REGIONS

No. Cities	Regions	Feb., 1924	Feb., 1923	Jan., 1924	Gain Feb.-Feb.	Gain Feb.-Jan.
89	East	$161,659,918	$117,280,033	$122,814,757	$44,379,885 38%	$38,845,161
109	Central	68,411,114	71,714,077	53,501,028	*3,302,963 5%	14,910,086
52	South	22,997,477	21,049,825	24,932,704	1,947,652 9%	*1,935,227
64	West	41,169,285	35,986,908	39,599,028	5,182,377 14%	1,570,257
314	Total	$294,237,794	$246,030,843	$240,847,517	$48,206,951 20%	$53,390,277

Note—(*) Indicates loss.

TWENTY-FIVE CITIES SHOWING LARGEST VOLUME OF PERMITS FOR FEBRUARY, 1924, WITH COMPARISONS

		Feb., 1924	Feb., 1923	Feb., 1922	Jan., 1924
1.	New York	$109,046,501	$79,730,453	$53,229,024	$76,098,606
2.	Chicago	18,694,410	27,712,400	13,493,800	14,117,110
3.	Los Angeles	16,083,412	12,080,310	7,579,798	13,158,526
4.	Rochester	11,500,000	623,910	365,615	954,985
5.	Detroit	11,257,549	7,228,375	3,281,631	7,122,376
6.	Philadelphia	7,173,885	6,799,960	5,381,435	8,642,525
7.	Boston	4,780,016	1,838,553	7,715,158	3,503,704
8.	Cleveland	4,390,725	4,257,650	1,484,090	4,391,350
9.	San Francisco	3,912,166	3,278,676	2,830,991	3,178,413
10.	Baltimore	3,345,600	4,049,130	3,268,920	3,528,000
11.	Indianapolis	2,714,162	1,601,282	1,170,398	1,012,221
12.	Portland, Ore	2,607,965	1,674,150	1,541,745	1,778,275
13.	St. Louis	2,339,885	2,664,900	1,285,735	3,481,167
14.	Washington, D. C	2,296,219	4,960,482	1,549,313	1,972,575
15.	Oakland, Calif	2,250,570	2,041,521	1,424,772	2,019,166
16.	Seattle	2,217,330	2,091,380	611,635	3,341,435
17.	Memphis	2,189,980	2,051,625	1,529,610	1,660,750
18.	Dallas	2,179,694	1,750,495	1,617,010	2,996,770
19.	Long Beach, Calif	2,156,132	3,045,285	1,164,084	3,198,048
20.	Newark	2,095,889	2,219,805	2,003,084	2,342,830
21.	Pittsburgh	2,034,006	1,798,244	1,805,924	2,004,184
22.	Providence, R. I	1,703,300	583,400	1,030,500	1,747,900
23.	Buffalo	1,641,000	1,600,000	1,596,000	1,244,000
24.	Denver	1,532,350	1,024,800	657,750	1,393,800
25.	Milwaukee	1,516,907	1,298,079	352,494	1,622,550
	Total	221,659,653	178,004,885	117,970,516	166,511,266



THIS IS THE WAY JOHN A. MERCIER, GENERAL CONTRACTOR, DETROIT, MICH., LOADS HIS CONCRETE MIXER AND EXCAVATOR FOR A QUICK SHIFT. THE EXCAVATOR ALONE WEIGHS 44,000 POUNDS

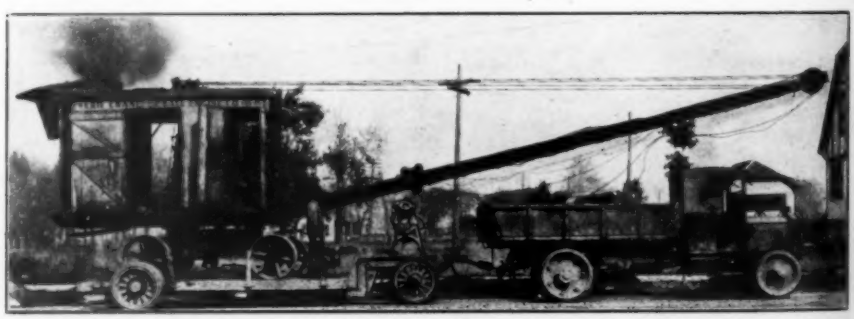
A Trailer for Handling Contractors' Machinery

New Drop-Frame Trailer a Big Help in Speeding Up the Moving of Equipment

EQUIPMENT manufacturers appreciate that the rapid transportation of steam shovels, ditchers and concrete mixers from one point to another saves much time and overhead. The endeavor of manufacturers to overcome the slow movement of some types of machinery is shown by the fact that some types of concrete mixers are equipped with pneumatic tires. It is impossible to equip a machine both with pneumatic tires, enabling it to travel quickly over hard roads, and with a crawler equipment, which will enable it to make headway on soft ground.

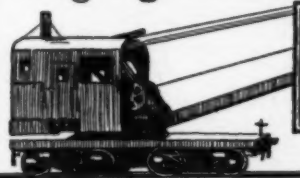
To overcome these difficulties, the Detroit Trailer Company, 954 East Milwaukee Avenue, Detroit, Mich., has brought out a 30-ton four-wheel drop-frame trailer especially built for handling steam shovels, ditching-machines and concrete mixers. The platform of the trailer illustrated is 108 inches wide by 20 feet long, the loading height from the ground being 22 inches. It has a 5-inch oak floor, and the frame is suspended from the axle. The axle is a 6- by 4-inch special alloy steel, and the tread is 130 inches. The trailer is equipped with solid rubber tires, making it possible to travel at a fair rate of speed on hard-surfaced roads. The trailers are equipped with the largest Timken roller bearings made.

As an example of the saving to a contractor through being able to move his equipment from one portion of the city to another, only a short time ago a steam shovel was loaded and towed 11 miles through the city of Detroit in an hour and 40 minutes and had to cross practically every one of the main streets of the city. It usually takes from three to four days to transport this shovel under its own power, and, in addition, traveling over the hard concrete is bad for the machine. One of the illustrations shows the shovel with smoke coming out of the chimney and steam still up, so that the shovel was ready for work within a few minutes after it arrived at its destination. The other illustration shows a truck on which a concrete mixer is mounted, hauling one of these new trailers in which an excavating machine is being carried.



A DETROIT TRAILER OWNED BY THE GEORGE B. COOKE CONSTRUCTION COMPANY IS USED TO HAUL THIS 85,000-POUND ERIE SHOVEL QUICKLY FROM ONE JOB TO ANOTHER

Equipment for Contractors



The catalogs and pamphlets listed below are available for free distribution. Contractors and Engineers who check over these pages each month and write for such material as interests them, will find this a valuable means of keeping up to date on the subject of machinery and equipment.

SELECTING THE RIGHT ROAD-PLANT

The reason that so many contractors have selected Blaw-Knox road and street forms, batcher plants, turntables and steel bins for road work is told in an interesting manner in the literature of the Blaw-Knox Co., 667 Farmer's Bank Bldg., Pittsburgh, Pa.

CARBIDE LIGHTS FOR NIGHT WORK

The Alexander Milburn Co., 1416-1428 West Baltimore Street, Baltimore, Md., has issued an interesting 24-page booklet on the Milburn light, a high-powered light for night work, which requires only ordinary commercial carbide and water to operate it.

ECONOMICAL MOTOR TRANSPORTATION

The use of Ford trucks and Fordson tractors for handling heavy machinery and supplies, and of the light model T Ford for pick-up work, gives economical transportation costs. Further facts may be secured from the Sales Dept., Ford Motor Co., Detroit, Mich.

THE USE OF EXPANSION JOINTS

Elastite expansion joints, which provide against expansion of concrete in bridges, viaducts, concrete retaining walls, roof slabs and pavements, are described in the literature of the Philip Carey Co., 9 Wayne Ave., Lockland, Cincinnati, Ohio.

SATISFACTORY PAVING ASPHALT

Inasmuch as the wearing qualities of any bituminous road depend largely on the binder, contractors should be sure that they use one which is satisfactory and dependable. Information regarding Stanolind paving asphalt, together with a booklet telling of the latest methods of constructing and maintaining asphalt pavements, may be secured by any interested contractors from the Standard Oil Co., of Indiana, 904 S. Michigan Ave., Chicago, Ill.

PAVING BETWEEN STREET RAILWAY TRACKS

W. S. Godwin Co., Inc., Race and McComas Sts., Baltimore, Md., has just issued a new booklet, "Paved Railways," describing the use of continuous steel ties and Godwin paving guards for street-railway paving.

POWER AND GRAVITY DUMPING EQUIPMENT

In Bulletins 131 and 132 issued by the Heil Co., Milwaukee, Wis., city officials and contractors will find complete descriptions of Heil horizontal Hydro Hoist dumping equipment for any make or model of motor truck and also the new gravity dump body for road work.

EXCAVATING AND MATERIAL HANDLING

The latest circulars of the Osgood Co., Marion, Ohio, particularly Nos. 237, 242 and 243, describe the use of steam shovels and draglines for sewer and trench excavating and material handling.

CUTTING COSTS WITH TRACTORS

A well-illustrated booklet issued by the Holt Mfg. Co., Peoria, Ill., tells why Holt Caterpillar tractors work so advantageously through top sod, heavy clay or gumbo, cutting down banks, making ditches, forming the crown and shaping the road for proper drainage—all jobs which require a powerful motor and positive traction.

PAINTING WITH COMPRESSED AIR

Bulletin No. 347 which may be secured from F. F. Hills, Pres., Spray Sales Co., 60 High St., Boston, Mass., describes in detail the Spraco system of painting with compressed air, which makes possible remarkable economies in industrial painting, house painting and both interior and exterior work.

SERVICEABLE ROAD MACHINERY

In catalog No. 24, the Austin-Western Road Machinery Co., 400 N. Michigan Blvd., Chicago, Ill., describes its complete line of road machinery, including graders, both large and small, with and without scarifier attachments, scarifiers, jaw crushers, portable and permanent, elevators, revolving screens, portable telescopic bins, portable gyratory crushers, complete crushing plants, the well-known Austin Pup road maintainer and roller, maintenance scarifiers, pressure road planes, back slopers and ditchers, corrugated riveted culvert pipe, motor road rollers with pneumatic scarifiers, steam rollers with scarifiers, pressure oilers, standardized sprinklers, horse-drawn street sweepers and motor pick-up sweepers, elevating graders, dump-wagons, wheeled scrapers, drag scrapers, fresnoes or buck scrapers, road and rooter plows and ditch plows.

METALLIC CONSTRUCTION IN HOMES AND BUILDINGS

Catalog No. 20 recently issued by the Milwaukee Corrugating Co., Milwaukee, Wis., is a manual on the use of reinforced rib and expanded metal construction for homes and buildings and includes a complete description of Milcor materials and methods, giving engineering tables, details and specifications, and general information on Milcor Stay-Rib and Netmesh expanded metal lath, expansion corner bead and casings, steel domes, channels and other fireproof building products.

AN UNUSUALLY ACCESSIBLE GAS ENGINE

The Denison Powermaker, made by the Cook Motor Co., Delaware, Ohio, is a particularly accessible gasoline or kerosene power unit for contracting work. It is described in detail in an illustrated folder which may be secured from the manufacturers.

A HALF-CRAWLER ROAD SHOVEL

The latest literature of the Keystone Driller Co., Beaver Falls, Pa., describes the new Model 4 Keystone excavator with front crawler traction. This outfit may be equipped with skimmer bucket or with drop-bottom, pull-stroke ditcher bucket.

GRADERS THAT STAND UP TO THE JOB

Adams graders which have the adjustable leaning wheel feature buckle down to the job and stand up to the worst conditions of operation. They are described in the latest catalog of J. D. Adams & Co., Dept. C. E. M., Indianapolis, Ind.

LOADERS FOR ROAD WORK

The Barber-Greene Co., Aurora, Ill., has issued an interesting book, "Results on Road Jobs—1924," which describes the use of the Barber-Greene disc feed loader on all types of road jobs. This book will be particularly helpful to street departments and contractors, as it contains many illustrations of job layouts.

DO YOU HANDLE CONCRETE?

If you have any concrete to handle, it will pay you to write for catalog No. 45 issued by the Insley Mfg. Co., Indianapolis, Ind., describing the Insley steel mast hoist, which has remarkable possibilities for the handling of either a 7S or a 14S batch and which is priced so that it does not mean the tying up of anticipated profits in equipment on a medium-size job.

WHEEL TYPE AND LADDER TYPE EXCAVATORS

Bulletin 16-X issued by Pawling & Harnischfeger Co., 3819 National Ave., Milwaukee, Wis., describes P & H ditch- and trench-digging machinery, including wheel type and ladder type trench excavators and drag lines which are also used for some classes of trench excavation and drainage ditches.

IMPROVED PANTAM MIXERS

A low-priced one-bag mixer which holds 10 feet of unmixed and 7 feet of mixed concrete and is light weight and easily snaked around the job to save wheelbarrow mileage and hauling to and from the mixer, is described in literature which may be secured from the Ransome Concrete Machinery Co., 1772 Second St., Dunellen, N. J.

SPEED, STRENGTH AND POWER IN TRUCKS

Motor trucks that are built oversize in every part of both engine and chassis to stand the stress of heavy daily contracting service and that have other special features are described in the GMC free booklet, "Seven Steps Ahead," which may be secured from the General Motors Truck Co., Pontiac, Mich.

DO YOU USE CALCIUM CHLORIDE?

A booklet, "For Concrete Summer and Winter," has been issued by the Semet-Solvay Co., Syracuse, N. Y., manufacturers of Solvay free-running calcium chloride which accelerates, hardens, freeze-proofs and waterproofs concrete and is a particular help in the curing of concrete construction.

AN INEXPENSIVE EMERGENCY PUMPER

The Barton portable pumper, which can be mounted on the crank-shaft of any car, using the motive power of the car, and which is adaptable to construction and road work, public works departments and even fire protection, is described in a folder that may be secured from the Barton Products Co., Jackson, Mich.

BETTER SERVICE THROUGH CLEAN WATER-MAINS

The literature of the National Water Main Cleaning Co., Hudson Terminal Bldg., New York City, describes the National method of cleaning water-mains and the remarkable results which have been secured in every city that has had its mains cleaned by this company.

LOCATING LEAKS AND WATER WASTE

Pitometer surveys are invaluable in checking up water waste and finding leaks even in 100 per cent metered water systems. The literature of the Pitometer Co., 52 Church St., New York City, will tell you all about Pitometer surveys.

A 1924 PAVER CATALOG

The 1924 Paver catalog of the T. L. Smith Co., Milwaukee, Wis., contains complete descriptions of Smith paver models and their particular features, together with half- and full-page illustrations of these pavers in action.

ROAD MACHINERY THAT PRODUCES RESULTS

Just how Stockland road machinery produces better, quicker and more economical results is told in the booklet, "Stockland Good Roads Manual," which may be secured from the Stockland Road Machinery Co., 3330 27th St., E., Minneapolis, Minn.

TESTED ROAD MACHINERY

Since it costs money to build roads, contractors want to use dependable machinery which will give first-class service and stay on the job until it is finished. "Everything for the Road Maker" is a free catalog, describing Climax, Monarch and Champion road machinery, made by the Good Roads Machinery Co., Kennett Square, Pa.

WIRE ROPE FOR CONTRACTORS

The latest catalog of the Williamsport Wire Rope Co., Peoples Gas Bldg., Chicago, Ill., which is just off the press, tells why so many manufacturers are using Williamsport Telfax tape-marked wire rope on contractors' equipment and why contractors are using it in all kinds of service.

EASILY MAINTAINED ROADS

A road which is claimed not to roll, wave or rut and which is skid-proof because of its granular surface is described in the Tarvia Road-Book of the Barrett Co., 40 Rector St., New York City.

WHAT KIND OF ROAD ROLLERS?

Catalog A, a completely illustrated piece of literature issued by the Buffalo-Springfield Roller Co., Springfield, Ohio, is a big help to the contractor, as it tells him just what type and size of road roller he needs for his work.

A POWERFUL MOTOR-TRUCK JACK

The Everready oil hydraulic jack for heavy trucks, which has features not embodied in any other jack on the market, is described in the folder which may be secured from the Everready Jack Co., Times Bldg., New York City.

SELF-DUMPING TRUCK BODIES

Sturdy, dependable, all-steel, self-dumping bodies for Ford trucks, complete and ready to install for $140, f.o.b. Detroit, tax extra, are described in the literature of the Wood Hydraulic Hoist & Body Co., 7938 Riopelle St., Detroit, Mich.

CAN YOU DRIVE CONCRETE PILES?

It requires the right kind of pile-driving hammers to successfully drive concrete piles. Bulletin 31 issued by the McKiernan-Terry Drill Co., 19 Park Row, New York City, describes McKiernan-Terry 9B and 11B double-acting steam hammers, the blows of which are controlled by the throttle.

AN ASPHALT-PRODUCING PLANT

Contractors who are particularly interested in the Littleford-Pullar asphalt-producing plant, which can produce any grade of asphalt from flux oil in the same time it takes to melt asphalt for road jobs, should secure, "A Great Achievement—Producing Blown Asphalt with a Portable Plant," a booklet describing this outfit, from Littleford Brothers, 500 East Pearl St., Cincinnati, Ohio.

WELL-BUILT HEAVY-DUTY MIXERS

No machine of the weight of a paving mixer can travel the inequalities of subgrades, pavement or roads without enduring terrific strain stresses unless the stresses are relieved by proper construction. A complete description of the structural features of the Koehring heavy-duty paver will be found in catalog P-5 which may be secured from the Koehring Co., Milwaukee, Wis.

TRUCKS FOR ALL KINDS OF LOADS

Whether you are hauling a snug load or a heavy, awkward load of lumber, you will find a truck built to stand up under the service desired, described in the literature of the Garford Motor Truck Co., Lima, Ohio.

SIX SPEEDS FORWARD INSTEAD OF TWO

The Warford selected type auxiliary transmission for Ford trucks gives six forward speeds with underdrive and overdrive combined in the same unit instead of the two normal forward speeds of the Ford truck. This quality drive for Fords is described in the literature of the Warford Corp., 44 Whitehall St., New York City.

ONE-MAN SHOVELS FOR ROAD AND GRAVEL WORK

The Michigan Dredge Co., Bay City, Mich., makes a one-man shovel which is particularly adapted for road work and gravel-pit work and which is described in illustrated literature that may be secured by any interested contractors.

PORTABLE TILTING MIXERS

The American Cement Machine Co., Keokuk, Iowa, has just issued a new set of illustrated specifications of the well-known Boss portable tilting batch-a-minute mixer which it will be pleased to send to any interested contractors. Ask for catalog CET-30.

Horizontal and Vertical Mechanical Dump-Truck Hoists

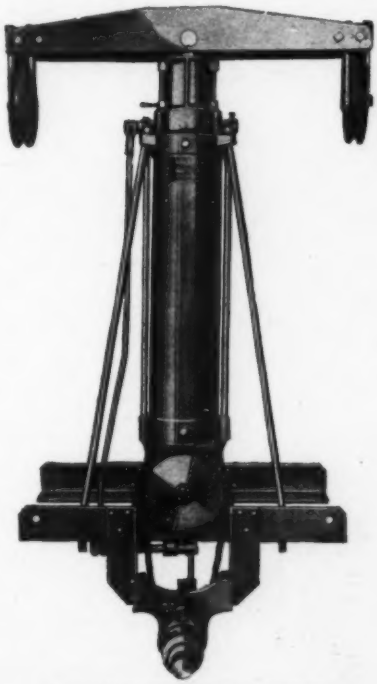
Two Types of Hoists Which Give Quick and Effective Service

SINCE more than three-quarters of the inquiries for truck hoists are now for the horizontal variety, according to the officials of the Van Dorn Iron Works Co., Cleveland, Ohio, a brief description of this type of hoist will be of interest. The hoist itself is bolted to the frame beneath the body by a three-point suspension to allow for all weave and twist of the truck. An ample-size roller chain connects the power take-off of the motor to the hoist. The connection between the hoist and the body is made by a link and lift arm to give the highest dumping angle and to allow a compact, "jack-knife" folding of the arm under the frame when the body is in its lowered position. The cut-away view shows the mechanical arrangement. The arm and link arrangement also forms a positive rigid connection at all times, regardless of the dumping angle of the body. There is no danger of the body's becoming overbalanced and tilting suddenly under the shifting of the load.

The hoist is controlled by a hand lever reached from the driver's seat, and can be stopped and lowered or locked rigidly at any dumping angle. It stops automatically at a dumping angle of 45 degrees, and the truck can be driving away while the body is lowering, as the hoist stops automatically as the body settles to its bed. This hoist is built in both light-duty and heavy-duty sizes.

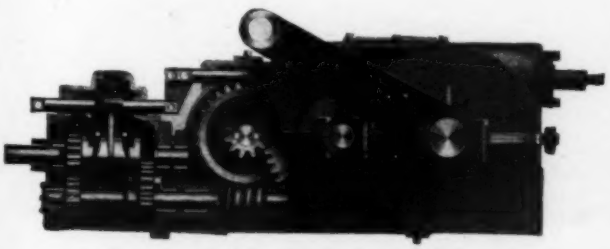
A vertical dump-truck hoist operated on the screw-jack principle is also manufactured by the Van Dorn Iron Works Company. This hoist, as well as the horizontal type, is said to speed up road dumping and will stand the racking strain and rough usage of dump-truck service with a minimum of operating and upkeep expense. It is built in two sizes—the light-duty hoist for 1- to 3-ton trucks, and the heavy-duty for 3½- to 7½-ton trucks.

This hoist is said to easily dump a 6-ton load in 20 seconds. The truck can be driving away while the body is lowered. The body can be stopped and held at any angle up to 45 degrees without danger of lowering the body as the load is being dumped or scattered. Gravity plays no part in the operation of lowering the body. The body can be lowered only by the power which raises it.



A VERTICAL HOIST FOR MOTOR DUMP-TRUCKS

The connection between the hoist and the truck body is made by ⅝-inch steel cable affixed to the truck body and rolling over the sheave wheels of the hoist and fastened to an eye-bolt at the base of hoist. The hoist itself is driven from the power take-off of the truck, which is connected with the bevel gears of the hoist. When a convenient control lever, reached from the driver's seat, is pushed to the rear, it meshes a steel jaw clutch fitted to the screw-shaft, with the upper beveled gear. This rotates the jack-screw in the proper direction to



A HORIZONTAL HOIST FOR MOTOR DUMP-TRUCK

raise a large bronze nut which is threaded to the jack-screw and fitted to the lower part of the plunger. When the plunger is driven up, the total load is supported by the heavy screw-shaft, which rests upon an ample-sized thrust bearing.

To lower the plunger, the hand lever is pulled forward. The clutch meshes with the lower beveled gear, and the jack-screw is rotated in a direction to pull down the bronze nut attached to the plunger, making the mechanism positive in action.

A Back-Action Shovel for Trench Work

New Piece of Machinery Eliminates the Straddling of Trenches and the Handling of Mats

THE economical digging of trenches for sewer and drainage jobs has long been a problem. For years standard shovels and draglines have been used in ditching and trench work, but as they must straddle the trench and lay mats across it, the flexibility and mobility of the machine is curtailed, and if the walls of the trench are not firm, there is always danger of a cave-in that may cause hours of delay and trouble. Where a wide trench with sloping sides is required, the dragline is satisfactory, but it is difficult to secure a square-cut deep trench with this type of machine.

After a careful study of drainage and sewer trench digging problems, the Northwest Engineering Company, 28 East Jackson Boulevard, Chicago, Ill., has developed a new machine called the trench Pull-Shovel, having the paramount advantage of the dragline, that of backing away from its work, and the digging ability of the shovel.

This machine is driven by a gasoline motor and is mounted on crawler treads, making it highly mobile. As it backs away from its work, it is always on firm ground, needing no mats, and it never has to straddle the trench. It is steered and operated by one man without swinging the cab. While standard shovels lose power as they dig deeper, the Pull-Shovel operates with its full power capacity up to 16 feet. On sewer work this machine digs a square, even-sided trench slightly wider than

A PULL-SHOVEL HANDLING THE EXCAVATION OF A SEWER TRENCH

its dipper, which comes in sizes of 24, 33 and 42 inches, and with its long reach and full digging power it can dig any depth up to 16 feet and pile quickly and easily to spoil banks, the same as the standard shovel.

By a change of booms, the Pull-Shovel can be converted to a dragline in a few hours' time. Thus, with two booms and the machine, the contractor is equipped to handle all kinds of drainage and sewer work. Should the operator desire a crane, he can, with a slight change in the dragline boom, have a machine that will handle a one-yard clam-shell, orange-peel, hook-block, or pile-driver leads, and by changing to another boom the machine can be converted to a standard shovel. With these attachments, the operator virtually has four machines in one.

It is said that the cost of moving from one job to another is greatly reduced by the Pull-Shovel, as it will load itself on a standard flat car under its own power and can be shipped without dismantling. This feature eliminates the usual high cost and lost time of preparing a machine for shipment by removing the cab, boom and traction base and erecting them at the destination, operations which are necessary with so many other machines.

Construction Machinery in Alley Paving

Schmidt Construction Company, Chicago, Ill., Has Motorized Its Jobs

CONCRETE alley paving is the specialty of the Schmidt Construction Company of Chicago, Ill. The average alley pavement in Chicago is 15 feet 4 inches wide, 7 inches thick, and about 1,100 square yards in extent. During the summer of 1923, two gangs, each with two Barber-Greene loaders, averaged about 1,000 yards in 8 hours on alley jobs. This meant moving from one set-up to another every day. The moves were about one-half mile and were completed in about an hour's time. The whole equipment was moved under its own power.

Before the Barber-Greene loaders and Clark Trucktractors were used, 15 men were necessary to shovel and load the material into the mixer, and the daily output averaged only 600 square yards of pavement, including moving time.

The shovelers were first replaced in the summer of 1920 by a Model 19 B-G loader on stone, and a light loader of another make on sand. With this combination for loading the Tructractors, production was increased from 600 square yards to 1,000 square yards average. The set-up now includes two B-G loaders, one working on the stock pile of stone on one side of the street, and the other on the sand pile on the opposite side. The second B-G loader has replaced the light loader.

Sand and stone were hauled in large trucks and stocked on the pavement at intersections near the alley entrance. Cement was also hauled in large trucks and stored on wagons near the other material. The amount of aggregate handled by the two loaders on each job is 180 cubic yards of stone for one loader, and 120 cubic yards of Torpedo for the other loader. This amount of aggregate does not keep the loaders busy, but it is the capacity of the mixer and the tractors for one day.

This descriptive article indicates how well-chosen equipment can help reduce costs on what some men might consider a small job.

PLANT LAYOUT OF THE SCHMIDT CONSTRUCTION COMPANY FOR ALLEY PAVING

Winter Construction Jobs All Over the Continent

Abstract of Remarks by J. Reid Kilpatrick Before New York Building Congress

THE report of the remarks of J. Reid Kilpatrick, Vice-President of the G. A. Fuller Company, at the meeting of the New York Building Congress appeared in a recent issue of *The American Contractor*, from which the following facts are abstracted. Mr. Kilpatrick said:

"The problem of winter construction is largely one of geography. The operation of our company extends from Florida to northern Canada and we run pretty nearly the whole gamut of temperature conditions. There is no problem of winter building up to and including Washington. Temperature conditions permit work all the year round, with very slight interruptions. When we get up to Philadelphia and New York the conditions become worse, and it grows progressively worse as we get up to Boston and above.

"As regards New York, we have prepared careful statistics extending from 1912 to 1922, a ten-year period, and we have found the average length of time that winter building programs will be rendered impossible because of temperature conditions is 14 days. This means that out of a whole winter there are on the average only 14 days in which one cannot work.

It was necessary to consider the figures for rather extended periods, because one job or two jobs or three jobs running one, two or three years would give a result which might mislead one in drawing general conclusions. The periods in which work is interrupted run from 5 to as high as 31 days.

"When we consider building in and around New York we have to divide it into certain different categories. There are four main groups into which construction in and around New York falls. First, there is house building. By that I mean the frame buildings such as are built in New Jersey and on Long Island and in the Bronx. Then come the five-story wall-bearing jobs, constructed throughout Brooklyn, Long Island City and the Bronx, the reinforced concrete factory work, and, lastly, skeleton steel construction, such as apartment houses, hotels, office buildings and loft buildings which develop a different problem.

"A different set of circumstances surrounds each one of these groups. I don't think there is much that we can do about the frame building. One cannot do a great deal in the country with isolated buildings in the winter time, and there is little hope of spreading that work over the entire year. The same reasoning applies to the five-story wall-bearing job. It is extremely hard to protect the men on wall-bearing jobs, because there is no hanging scaffold on which to suspend the protection. It is hard to expect that type of construction to extend over the entire year.

"In New York, the frame-building and five-story wall-bearing job will be started in April or in the early spring and be cleaned up by fall. They take only from six to seven months to build.

Prominent Winter Jobs

"There is nothing new about winter construction. It has been done for years. Going back over 20 years, we find some of our most prominent buildings in New York were built in the winter time. The Atlantic Mutual Building and the Broad Street Exchange Building were completed during the winter of 1900-1901. The methods of carrying them on were very similar to those which prevail to-day. The only difference is that in those days there were no hanging scaffolds, and instead of hanging the tarpaulins to protect the bricklayers on the scaffold itself, a light framework was built up which was attached to the steel on the floor above. Our present problem of protecting the bricklayer is somewhat easier, because the hanging scaffold makes it quite simple.

"Excavating is now just as simple and easy in the winter as it is at any other time of the year. We never see hand excavation any more. It is all done by steam shovels, which can work in frozen ground very nearly as easily as they can when the ground is soft. The placing of the concrete is not a serious problem. It is a very simple matter to heat the aggregate. The manner in which it was heated years ago is still used, consisting of getting a large section of corrugated iron pipe, building a fire in it, and putting the sand and stone on top to keep the frost out.

"Concrete can be poured with a reasonable degree of safety down below 20 degrees above zero, provided it is protected at night by merely placing tar paper on top of the work. We have poured concrete at 40 degrees below zero in Canada. That was a different problem. Steam heat had to be used, and the work had to be housed in, but foundation work in New York is easy to handle.

Steel Set in Any Weather

"In structural steel there is no particular problem. The work may be interrupted by snow-storms, but the quantity of work a man does is not restricted by the temperature. The opinion has existed for some time that steel work in winter is particularly hazardous on account of the ice and snow. I have investigated this and found that there really is no difference.

"We can lay brick at from 23 to 25 degrees above zero, and as our various foremen have

told us, they are convinced that we can go considerably lower than that if necessary. However, the common opinion is that it is bad to get under 20 degrees.

"The normal steel job extends over a year period. Splitting the year up into three four-month periods, such as August, September, October and November for the fall, December January, February, and March for winter, and the remaining four months for the spring and summer, there is no particular difference in the analysis for a period. No matter whether the job begins in the winter months or whether it begins in the summer and goes up to the spring or early summer, there is no difference in our figures of costs; in fact, we prefer to start in the fall to clean up the excavating so that the structural steel can be set in November or December. This carries the masonry and outside work on during the winter. That just misses the peak demand for mechanics we use, and fits in exactly with the program of the New York Building Congress.

"It is difficult to analyze the cost figures and determine whether one actually makes more money by building in winter than in spring or summer. However, we prefer to set our steel and put in our brick work in the winter months. It is easier to get the finishing trades. Winter work also avoids the peak loads of the finishing trades. Winter work is not new, revolutionary or untried. We have been doing it in New York on big jobs for the last 23 years, and anything that can help iron out the peaks in employment and build up the depressions cannot help but be an excellent thing for the building industry and allied interests."

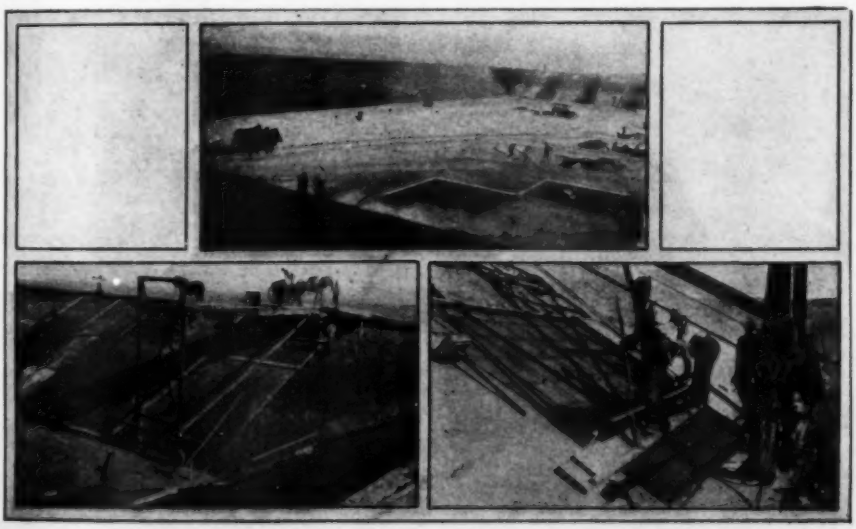
The New Grand Junction Reservoir

A 13,500,000-Gallon Reserve Reservoir Protects City Water-Supply

ABOUT a year ago Grand Junction, Colo., which has a population of about 12,000, voted $195,000 in bonds for water-works improvements to the present supply, which is secured from a gravity line from Kannah Creek, 20 miles west of the city. The long flow line of steel and wood stave pipe was occasionally damaged and put out of commission through landslides and torrential rains, which justified the city in planning for the construction of a large reserve reservoir near-by. It will tide the water-supply over during the times when the supply lines are out of commission for repairs.

The new 13,500,000-gallon reservoir is now about completed. The construction details are somewhat unusual in their simplicity, low expense, and arrangement for handling and placing the concrete, which has enabled the contractors to do the work with greater rapidity than on most reservoirs of similar nature.

The reservoir has a reinforced concrete lining on an earth embankment. The side slopes are 1¾ to 1. Slabs on the side slopes are 6 inches thick, with a membrane waterproofing between a 4-inch and a 2-inch top layer. The bottom of the reservoir, which covers about 2 acres, is of 5-inch concrete slabs



SCENES IN THE CONSTRUCTION OF THE GRAND JUNCTION RESERVOIR

At top, finishing alternate slabs in reservoir floor. At left, moving platform which facilitated the placing of concrete on the slopes. At right, spading and tamping concrete on slopes of reservoir

20 feet square resting on concrete beams at the joints. The beams are waterproofed and hold a waterproofing joint material between the edges of the slabs. The slabs on the slope and bottom were put in in alternate sections. The platform from which concrete was discharged was placed on wheels at the toe of the slope and wheels at the top of the slope, so that the platform could be readily moved from one position to the other and the concrete discharged on top of the platform and placed through a flexible chute.

The reservoir was built by the Ormon Construction Company of Pueblo, Colo., at a cost of approximately $75,000. M. H. Walser was the supervising engineer for Burns & McDonnell, Kansas City, Mo., consulting engineers for the work, and the entire project was carried out under the general direction of George Garrett, City Manager of Grand Junction.

The reservoir will give the city a reserve storage of about four times the average day's water consumption.

An Amphibious 22-Ton Shovel

Trip up River Instead of Dismantling and Lowering Machine from Cliffs Saves One Week

IN order to speed up the excavation of the foundation for the new dam of the Dells Paper and Pulp Company, of Eau Claire, Wis., so that the foundation could be poured before freezing, a ¾-yard gasoline shovel was purchased. The dam is at a point in the river where there is a high bluff on each side. It was planned to dismantle the machine and skid the parts out onto a platform from which they would be lowered by derricks 70 or 80 feet and reassembled. This scheme would have taken at least a week and much labor, beside the continuous payment of wages for 25 or 30 shovelers whose work the machine was to handle.

A representative of Pawling & Harnischfeger Company, Milwaukee, Wis., hearing of this condition and wishing to be of service to the purchaser of the machine, went to look over the job. This engineer reported that the machine could be run into the river about a quarter of a mile below the dam and moved under its own power to the coffer-dam. This did not seem possible to the owners, who knew the treacherous condition of the river bottom, which was full of deep holes and ledges. However, with the assurance of the builders that the machine would stand the trip, they decided to take a chance, and the machine was started into the river at eleven o'clock on Saturday with three men aboard. Many times during the trip it looked very bad to the watchers on the bluff. The machine ran over ledges and would rear up like a duck taking a dive. At other times it would run into holes that could not be avoided, and the water would almost reach the magneto and carburetor, the current getting swifter as the machine neared the dam.

22-TON SHOVEL STARTING ON ITS JOURNEY UP-STREAM

After several hours in the swift, black water the coffer-dam was reached. Another hour was required to reinforce the planking and supports, and the machine came up out of the water like a huge hippopotamus and crawled over the dam and down into the hole 12 feet below, taking just 5½ hours for three men to do the trick. That the manufacturers' confidence in the machine is catching is proved by the fact that on this job the owners are now running the machine around the river like a rubber duck.

Recommended Minimum Requirements for Masonry Wall Construction

Features of the Tentative Report of the Building Code Committee of the Department of Commerce

SEVERAL independent analyses have indicated forcefully that present municipal code requirements for masonry wall construction are uneconomical, unnecessarily restrictive of building enterprise, and lacking in that uniformity which makes for greatest convenience to designers and builders. The recent report of the Building Code Committee of the Department of Commerce presents the results of some of these analyses, describes investigations of the factors affecting such requirements, and presents in tentative form recommendations for uniform code practice.

The Building Code Committee was organized early in 1921 in response to a generally expressed public demand for greater uniformity and economy of building code requirements. Its first work was concerned with regulations affecting construction of small dwellings, and the final report on that subject, under the title, "Recommended Minimum Requirements for Small Dwelling Construction," was published in January, 1923.

Subsequent to its organization the Committee made an extensive canvass of professional opinion as to what phases of building code requirements were in most urgent need of revision and standardization. This canvass developed that masonry walls vary widely in required thickness and dimensions, that masonry stresses and fire-resistance requirements are based on inadequate knowledge of the performance of walls under loading and fire exposure, and that as a result there is lack of safety in some localities and unnecessary use of material and labor in others.

The report deals with the construction of exterior and interior masonry walls and those of plain concrete for all buildings, including those for dwellings, where the occupancy is not more than two families, these latter having been treated more specifically in the recommended minimum requirements for small dwelling construction previously mentioned.

It is recognized that the requirements proposed constitute in some particulars relaxation from those enforced in certain cities and parts of the country, but the committee feels that it is justified from the facts developed by its investigations. The recommendations are predicated on the assumption that good materials and workmanship will be used and all necessary care taken in assembling the various parts of the structure. It is known that certain code provisions applying to walls and other structural parts which might be classified as extreme reflect in part the purpose of their writers to offset poor design or workmanship by a greater factor of safety. In effect, such codes penalize the builders by requiring additional material and labor because of the city's failure to provide or compel the provision of adequate and competent supervision of building work. It is felt that the extra expense thus caused more than warrants energetic measures to insure such supervision and that it is the duty of all concerned with planning and supervising building construction, both to the public and to their clients, to use every influence toward securing it.

Where responsible supervision can be assured, the code requirements recommended in his report are believed safe. Where this is not the case, relaxation of more elaborate or expensive existing requirements is not advocated. In modifying their code provisions to reduce cost, local authorities should insist upon supervision of construction by an adequate, experienced personnel. At the same time, city building inspectors should avoid the other extreme. There is a tendency for the building inspection departments of municipalities to forget that theirs is primarily a police function, concerned only with public safety, and to lay too much stress on matters which are good building practice but have nothing to do with the police power. This is reflected to a certain extent in some recent building codes, and in preparing these recommendations the effort has been made to keep them within the bounds of simplicity necessitated by safety considerations. The recommendations of the Committee are in no sense obligatory but are purely advisory.

ARTICLE I

Definitions

Section 1. *Definitions*

1. Bearing Wall: A wall which supports any vertical load other than its own weight.
2. Non-Bearing Wall: A wall which supports no load other than its own weight.
3. Curtain Wall: A non-bearing wall between columns or piers which is not supported at each story by girders or beams.
4. Panel Wall: A non-bearing wall in skeleton construction built between columns or piers and supported at each story. See Appendix, par. 4.
5. Party Wall: A wall used or adapted for joint service between two buildings, or, a wall between two buildings separating two properties, but used, or adapted for use, jointly.
6. Division Wall: Any interior wall in a building. See Appendix, par. 5.
7. Fire-Wall: A wall subdividing a building to restrict the spread of fire. It shall have such thickness as to prevent communication of fire by heat conduction. It shall have such stability as to remain intact after complete combustion of the contents of the building on one side of the wall; and its structural integrity shall be such as to be unaffected by any wreckage resulting from the fire or its extinguishment. In all buildings it shall start at the foundation, be continuous through all stories, and extend above the roof.
8. Masonry: For the purposes of this report the term "masonry" shall be understood to mean stone, brick, hollow building tile, concrete block, or other similar building units bonded together with mortar to form a wall, pier or buttress. See Appendix, par. 6.
9. Portland Cement Mortar: A mortar composed

of one part Portland cement to three parts of sand, proportioned by volume, with an allowable addition of hydrated lime not to exceed 15 per cent of the cement by volume.

10. Cement-Lime Mortar: A mortar composed of one part Portland cement, one part hydrated lime, and six parts of sand, proportioned by volume.

11. Lime Mortar: A mortar composed of one part slaked lime (lime putty) or dry hydrated lime and not more than four parts of sand proportioned by volume.

12. Natural Cement Mortar: A mortar composed of one part natural cement to three parts of sand, proportioned by volume.

13. Ashlar Masonry: Masonry of smooth, dressed, tooled or quarry-faced, squared stone with proper bond.

14. Ashlar Facing: Masonry of sawed or dressed, squared stones used in facing masonry walls.

15. Rough or Ordinary Rubble Masonry composed of unsquared or field stones laid without regularity of coursing.

16. Coursed Rubble: Masonry composed of roughly shaped stones fitting approximately on level beds and well bonded.

17. Random Rubble: Masonry composed of unsquared stones laid without regularity of coursing but fitting together to form well-defined joints.

18. Rubble Concrete: Portland cement concrete in which the finer materials form a matrix for large stones and boulders (cyclopean concrete).

ARTICLE II

Solid Brick Walls

Section 2. *Brick and Mortar Materials*

Clay or sand-lime brick used for bearing walls or piers shall be of quality at least equal to the "medium brick" described by the Standard Specifications for Building Brick, of the American Society for Testing Materials. When used for non-bearing purposes and not exposed to the weather, such brick may be of quality not inferior in any respect to the "soft brick" described in the above specifications. See Appendix, par. 7.

The average compressive strength of concrete brick 28 days after being manufactured or when shipped shall be not less than 1,500 pounds per square inch of gross cross-sectional area as laid in the wall, and the compressive strength of any individual brick shall be not less than 1,000 pounds per square inch of gross cross-sectional area as laid in the wall.

Concrete brick subjected to a 24-hour immersion test shall not absorb more than 12 per cent of their dry weight except when they are made of concrete weighing less than 140 pounds per cubic foot. For brick made of concrete weighing less than 140 pounds per cubic foot the average absorption in per cent by weight shall not be more than 10 multiplied by 140 and divided by the unit weight in pounds per cubic foot of the concrete under consideration. See Appendix, par. 7.

All cements and limes used in mortar shall conform to the requirements of the Standard Specifications for these materials issued by the American Society for Testing Materials.

Sand used in mortar shall be clean and free from organic matter; not more than 30 per cent shall pass through a No. 50 standard sieve and 100 per cent shall pass through a No. 8 standard sieve. See Appendix, par. 8.

For precautions necessary in laying brickwork in freezing weather or in warm, dry weather, see Appendix, par. 11, Workmanship.

Section 3. *Lateral Support of Walls*

All walls shall be provided with adequate lateral support at intervals of not more than 20 times the wall thickness in either a horizontal or a vertical direction, and shall be supported in the other direction at intervals of not more than 60 times the wall thickness for buildings of wood-joist construction, 90 times the wall thickness for steel frame, fire-resistive buildings, or those of mill or slow-burning construction, and 120 times the wall thickness for buildings of reinforced concrete construction. See Appendix, par. 10.

Section 4. *Stresses in Brick Masonry*

The maximum allowable compressive stress in brick masonry due to combined live and dead loads shall not exceed the following limits. These stresses are to be considered as the absolute maxima, allowing for the added effect of eccentricity of loading and lateral forces. See Appendix, pars. 11, 12 and 18.

	Maximum Unit Working Stresses Pounds per Square Inch		
		Natural Cement or Cement-Lime Mortar	
	P. Cement Mortar		Lime Mortar
Clay brick, medium grade	250	200	125
Sand-lime brick	250	200	125
Concrete brick	250	200	...

Section 5. *Thickness of Exterior Walls*

The thickness of solid brick bearing walls shall be sufficient at all points to keep the stresses due to live and dead loads for which the building is designed within the limits prescribed by Section 4.

The minimum thickness for solid brick exterior bearing walls shall be 12 inches for the uppermost 35 feet of their height, and shall be increased 4 inches for each successive 35 feet or fraction thereof, measured downward from the top of the wall, except that the wall of a top story not exceeding 14 feet unsupported height, or of a one-story commercial or industrial building not exceeding 14 feet unsupported height may be 8 inches thick; and that exterior solid brick bearing walls of buildings designed only for residential purposes may be 8 inches thick when not more than 30 feet in height. When gable construction is used, an additional 5 feet is permitted to the peak of the gable. See Part II, Section 3, Lateral Support for Walls.

Where walls are stiffened at distances not greater than 12 feet apart by cross-walls, or by internal or external returns at least 2 feet deep, such walls may be 12 inches thick for the upper 70 feet and increased 4 inches in thickness for each successive 70 feet or fraction thereof, except that the top story may remain 8 inches thick as previously provided.

The minimum thickness of solid brick exterior non-bearing walls shall be 12 inches for the uppermost 70 feet of their height, and shall be increased 4 inches for each successive 35 feet or fraction thereof, measured downward from the top of the wall, except that the wall of a top story not exceeding 14 feet unsupported height, or of a one-story commercial or industrial building not exceeding 14 feet unsupported height, may be 8 inches thick; and that exterior solid brick non-bearing walls of buildings designed only for residential purposes may be 8 inches when not more than 30 feet in height. When gable construction is used, an additional 5 feet is permitted to the peak of the gable. See Appendix, pars. 14, 15 and 16.

Section 6. *Bond*

In all brick walls at least every sixth course shall be a header course, or there shall be at least one full-length header in every 72 square inches of wall surface. All walls shall be securely bonded or anchored at points where they intersect.

Section 7. *Piers*

The unsupported height of isolated piers shall not exceed 10 times their least dimension. See Appendix, par. 17.

Section 8. *Chases and Recesses.*

There shall be no chases in 8-inch walls or within the required area of any pier, and no chase in any wall shall be deeper than one-third the thickness of the wall. No horizontal chase in any wall shall exceed 4 feet in length.

Recesses for stairways or elevators may be left in the walls of buildings, but in no case shall the walls be less than the required thickness of walls of the fourth story, unless reinforced by additional piers, with steel girders, or steel columns and girders, securely anchored to walls on each side. Recesses for alcoves and similar purposes shall have not less than 8 inches of material at the back. Such recesses shall be not more than 8 feet in width and shall be arched over or spanned with steel lintels, and not extend nearer than 18 inches from the bottom of the floor beams next above.

The aggregate area of recesses and chases in any

Note: The expression "exterior walls" as used in the above paragraphs and elsewhere in this report is understood to include party and lot-line walls. The word "solid" is to distinguish the walls so designated from those of hollow construction. See Article III.

wall shall not exceed one-fourth of the whole area of the face of the wall in any story. No recess shall be made within a distance of 6 feet from any other recess in the same wall.

No chases or recesses shall be permitted in fire walls.

Arches and Lintels. See Appendix, par. 19.

ARTICLE III

Walls of Clay Hollow Building Tile, Hollow Concrete Block and Hollow Walls of Brick

Section 9. *Quality of Materials*

Clay hollow building tile: The average compressive strength of clay hollow building tile used for exterior or party walls or piers, laid with the cells vertical, shall be not less than 1,200 pounds per square inch of gross sectional area tested in that position.

The average compressive strength of clay hollow building tile laid with the cells horizontal, shall be not less than 700 pounds per square inch of gross sectional area, tested in that position.

Hollow concrete block: The average compressive strength of hollow concrete block used for exterior or party walls or piers shall be not less than 700 pounds per square inch of gross sectional area tested as used in the wall. The absorption of hollow concrete block or tile shall not exceed 10 per cent under a 48-hour test. Tests on concrete block shall be conducted in accordance with Standard Specifications of the American Concrete Institute. See Appendix, par. 20.

Brick: Brick for hollow walls shall conform to requirements of Part II, Section 2.

Mortar: Either cement mortar, or cement-lime mortar, as defined in Section 1, shall be used for walls of hollow unit construction or hollow walls of brick.

Section 10. *New Masonry Materials*

The use of new or improved masonry materials hereafter developed will be permitted, providing that they shall conform to specifications ensuring reasonable uniformity of the product, and that their unit working stress shall be fixed at not more than ten (10) per cent of the average ultimate strength of masonry walls constructed of such materials, as determined by responsible authorities.

Section 11. *Lateral Support of Walls*

Requirements for lateral support of walls of clay hollow building tile, hollow concrete block, or hollow walls of brick shall be the same as given in Part II, Section 3, for solid brick walls.

Section 12. *Stresses*

The maximum allowable compressive stress in walls or piers of clay hollow building tile, hollow concrete block, or hollow walls of brick, due to combined live and dead loads, shall not exceed 125 pounds per square inch of gross sectional area, where laid with Portland cement mortar, and 100 pounds per square inch of gross sectional area where laid with natural cement or cement-lime mortar. See Appendix, par. 21.

Section 13. *Thickness and Height of Exterior Walls*

Walls of clay hollow building tile, hollow concrete block, or hollow walls of brick shall not exceed 50 feet in height above foundations.

The thickness of bearing walls of the above types shall be sufficient at all points to keep the stresses due to live and dead loads for which the building is designed within the limits prescribed by Section 12.

The minimum thickness of exterior walls of clay hollow building tile, or hollow concrete block or of hollow wall construction shall be 12 inches for the uppermost 35 feet of their height, and shall be at least 16 inches for the remaining lower portion; except that the wall of a top story not exceeding 14 feet in unsupported height, or of a one-story commercial or industrial building 14 feet in unsupported height, may be 8 inches thick, and except that for residential buildings not more than three stories in height, exterior walls may be 8 inches for the uppermost 20 feet. When gable construction is used an additional 5 feet is permitted to the peak of the gable.

Where walls of the above types are stiffened at distances not greater than 12 feet by cross-walls or by internal or external returns at least 2 feet deep, such walls may be 12 inches thick throughout, except that the top story may remain 8 inches thick, as previously provided.

Section 14. *Bond*

Clay hollow building tile for load bearing purposes shall be laid with cells vertical and shall have vertical joints broken in successive courses and the webs and shells of each course directly over those of the course below, or shall have all beds or horizontal bearings reinforced with metal fabric of mesh not less than ½-, nor greater than ¾-inch, which shall extend to the approximate full thickness of the wall and shall be capable of holding the mortar. The metal fabric shall be spread on each course before mortar is applied, shall be double-lapped at corners of the wall, and shall be completely covered with and embedded in Portland cement mortar as the tile are laid.

Section 15. *Piers*

Clay hollow building tile or hollow concrete block shall not be used for isolated piers unless solidly filled with concrete. The unsupported height of such piers shall not exceed ten times their least horizontal dimension.

Section 16. *Chases and Recesses*

Chases and recesses in walls of clay hollow building tile, hollow concrete block, or in hollow walls of brick shall not exceed in extent those permitted for solid brick walls under the same conditions. Chases and recesses shall not be cut in walls of the above types, but may be built in. No chases or recesses shall be permitted in fire walls.

ARTICLE IV

Walls of Plain Concrete

Section 17. *Concrete Materials*

Monolithic concrete construction containing not more than 2/10 of 1 per cent of reinforcement shall be classed as plain concrete.

Materials for bearing walls and piers of plain concrete shall be mixed in proportions of not less than 5 parts of coarse aggregate and 2½ parts of sand to 1 part of Portland cement, by volume.

Coarse aggregate shall consist of crushed stone or gravel which is retained on a screen having ¼-inch diameter holes, and shall be graded in size from small to large particles. The maximum size shall be such that all the aggregate will pass through a 1¼-inch diameter ring. The particles shall be clean, hard, durable, and free from all deleterious material.

Cement, lime and sand used for plain concrete shall conform to the requirements given in Part II, Section 2, except that sand passing a No. 4 standard sieve may be used.

Section 18. *Lateral Support of Walls*

Requirements for lateral support of plain concrete walls shall be the same as those for brick walls, given in Part II, Section 3.

Section 19. *Stresses*

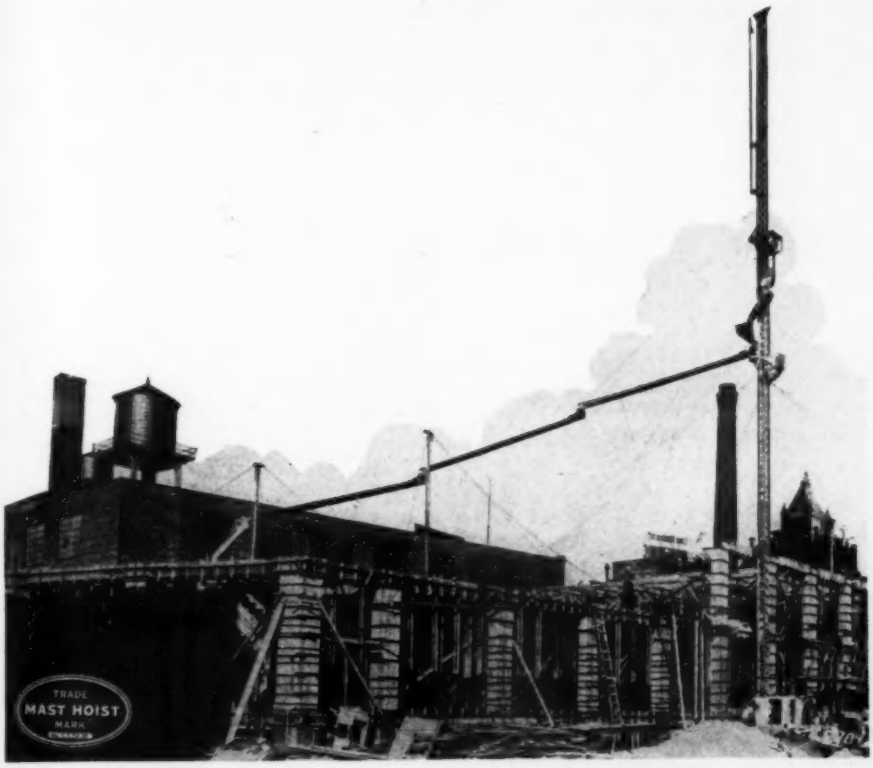
The maximum allowable compressive stress in plain concrete due to combined live and dead loads shall not exceed 250 pounds per square inch in walls and piers; or 350 pounds per square inch in foundations.

Section 20. *Thickness of Walls*

The thickness of plain concrete walls shall be 12 inches for the uppermost 35 feet of their height and shall be increased 4 inches for the remaining lower portion, except that the wall of a top story not exceeding 14 feet unsupported height, or of a one-story commercial or industrial building of 14 feet unsupported height may be 8 inches thick; and that exterior bearing walls of buildings designed only for residential purposes may be 6 inches thick when not more than 30 feet in height. When gable construction is used an additional 5 feet is permitted to the peak of the gable.

Hollow monolithic walls of plain concrete shall have the same total thickness of material, irrespective of the space within the wall, as required for solid walls. The inner and outer parts of such walls shall be securely braced and tied together with non-corrodible ties or other means to bring them into common action. Where floor and roof systems are carried by such walls, provision shall be made for the distribution of these loads to all parts of the wall.

Where walls are stiffened at distances not greater than 12 feet apart by cross-walls, or by internal or external returns at least 2 feet deep, such walls may be 12 inches thick for the entire height, except



Greater Possibilities

THE INSLEY STEEL MAST HOIST plant has greater possibilities for the handling of either a 7-S or 14-S batch than almost any other equipment available to the concrete builder.

Its purchase and erection costs are such it does not mean the tying up of anticipated profits in equipment on the medium sized job.

Its operating efficiency is superior to that of the wood tower equipment heretofore used in that it is possible to reach 60 ft. with self supported chuting.

Its salvage value is high in that outside of chutes and sheaves there are practically no parts subject to wear. It is good for job after job.

If you have concrete to build it will pay you to write for Catalog No. 45.

INSLEY MANUFACTURING CO.

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INDIANAPOLIS

that the top story may remain 8 inches thick as previously provided.

Section 21. *Bond*

Reinforcement not less than 2/10 of 1 per cent, computed on a vertical height of 12 inches, shall be placed over all wall openings and at corners of the structure to prevent cracks. Floor and roof connection details shall be designed to transmit safely the vertical and horizontal loads imposed.

Sections 22. *Piers*

The unsupported height of isolated piers of plain concrete shall not exceed 10 times their least dimension.

Section 23. *Chases and Recesses*

Chases and recesses in plain concrete walls shall not exceed in extent those permitted for solid brick walls under the same conditions. See Part II, Section 8.

ARTICLE V

Stone Walls

Section 24. *Stresses*

The maximum allowable compressive stress in rubble stonework due to combined live and dead loads shall not exceed 140 pounds per square inch for masonry laid in Portland cement mortar, 100 pounds per square inch laid in natural cement or cement-lime mortar, and 70 pounds per square inch laid in lime mortar.

The maximum allowable compressive stress in cut stone masonry due to combined live and dead loads shall not exceed 250 pounds per square inch for masonry laid in Portland cement mortar, 200 pounds per square inch laid in natural cement or cement-lime mortar, and 125 pounds per square inch laid in lime mortar. See Appendix, par. 22.

Section 25. *Thickness*

1. All kinds of rubble stone walls shall be 4 inches thicker than is required for solid brick walls under the same conditions, but in no part less than 16 inches.

2. Walls and piers of ashlar masonry may be of the same thickness throughout as is required for solid brick walls under the same conditions.

Section 26. *Height*

Walls of ordinary or random rubble shall not exceed 35 feet in height, exclusive of foundation. Walls of coursed rubble masonry shall not exceed 50 feet in height.

Section 27. *Bond*

Ashlar masonry used for bearing walls shall have the alternate courses on opposite sides well bonded across the bed.

Walls of rubble masonry shall have at least one bond stone extending entirely through the wall in each 3 square feet of surface.

Section 28. *Piers*

Except in unexcavated spaces, stone posts or piers shall not be used as supports for girders or walls.

Section 29. *Chases and Recesses*

Chases and recesses in stone walls shall not exceed in extent those permitted for solid brick walls under the same conditions. See Part II, Section 8.

ARTICLE VI

Faced and Veneered Walls

Section 30. *Quality of Materials*

Materials used in faced and veneered walls shall conform in all respects to the requirements prescribed for such materials in Part II, Sections 2, 9, and 17.

Section 31. *Stresses*

Maximum stresses in faced and veneered walls due to combined live and dead loads shall not exceed those elsewhere prescribed for masonry of the type which forms the major thickness or bearing portion of such walls.

Section 32. *Thickness and Bonding*

1. Face brick, if bonded to common brick backing with at least one full header in every 72 square inches of wall surface may be considered as part of the wall in computing the necessary thickness and bearing strength. Where the face brick is bonded with metal ties, it shall not be considered a part of the required thickness of the wall.

2. When walls of hollow blocks are veneered with brick, the facing shall either be bonded to the backing with a row of headers at intervals of not more than 18 inches, or shall be attached to the backing with approved metal wall ties bedded in the mortar joints. Such ties shall not be spaced farther apart on centers than 1 foot vertically and 2 feet horizontally. Veneering attached with metal ties shall not be considered a part of the required thickness of the wall. Brick facing or veneering may, however, be considered as part of a clay hollow building tile or hollow concrete block wall (or vice versa), provided the veneering is bonded at least 4 inches into the wall. When veneering is used, special care shall be taken to fill all joints flush with mortar around wall openings.

Section 33. *Ashlar Facing*

Stone or architectural terra cotta ashlar, or other approved material used for wall facing shall be not less than 3¾ inches thick. In stone ashlar, each stone shall have a reasonably uniform thickness, but all stones need not necessarily be the same thickness. Each block of ashlar or other approved facing shall either be bonded into the backing, or be securely anchored to the backing with non-corrodible metallic anchors, at least one for each 3d inches lineal length of course, and the backing independent of facing shall conform to the wall thickness elsewhere required. Where every alternate course of stone facing is at least 7½ inches thick and bonded into the backing at least 3¾ inches, and no course is more than 16 inches in height, the ashlar may be counted as part of the thickness of the wall. No wall faced with ashlar shall have less than 12 inches total thickness, provided that at least 20 per cent of the superficial area of the wall facing is 4 inches thicker than the remainder to form bonds uniformly distributed.

ARTICLE VII

Fire-Walls and Partitions

Section 34. *Brick and Plain Concrete Fire-Walls**

Solid brick or plain concrete fire-walls shall be not less in thickness than required for exterior bearing walls of corresponding height, except that fire-walls for residential buildings not more than 3 stories in height may be 8 inches thick for the uppermost 20 feet of height and shall be at least 12 inches thick for the remaining lower portion. No 8-inch fire-wall shall be broken into for the insertion of building members. See Appendix, par. 23-2. For definition of fire-wall see Part II, Section I.

Section 35. *Fire-Walls of Clay Hollow Building Tile, Hollow Concrete Block or of Hollow Wall Construction*

Fire-walls of clay hollow building tile or hollow concrete block shall be not less than 16 inches thick in any part, except that in residential buildings not over three stories high they may be 12 inches thick throughout. Hollow walls of brick used as fire-walls shall be not less than 12 inches thick throughout. No fire-walls of the above types shall be broken into for the insertion of building members. See Appendix, par. 23-1.

Section 36. *Parapet Walls*

In commercial or industrial buildings and in residential buildings over three stories high, all fire or party walls shall have parapet walls projecting above the roof.

Where not otherwise specified, parapet walls shall be at least 32 inches high, but not higher than four times their thickness unless supported by steel or reinforcing piers. They shall be at least as thick as the top-story wall, except that they need not in any case be more than 12 inches thick.

In residential buildings not more than three stories high parapet walls shall project through combustible roofs to a height of at least 12 inches. All parapet walls shall be coped. See Appendix, par. 24.

Section 37. *Brick Partitions*

Solid brick bearing partitions, where not utilized as party, fire or division walls, shall be not less than 8 inches thick. Brick non-bearing partitions may be not less than 4 inches thick for a height not exceeding 12 feet between floors or floor beams and a length of not more than 20 feet between vertical supports.

Section 38. *Partitions of Clay Hollow Building Tile, Hollow Concrete Block or Hollow Walls of Brick*

Bearing partitions of clay hollow building tile, concrete blocks or hollow walls of brick, where not util-

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*Note: Party walls are exterior walls, but usually function also as fire-walls. When this is the case they should conform to requirements for fire-walls.

How the McArthur Construction Company of Kenton, Ohio, Reduced Their Hauling Costs 38%

October 9, 1923.

Whitehead & Kales Co.,
Detroit, Mich.

Attention H. O. Mainsinger.

Gentlemen:-

During the season just closing we purchased from you four, W & K 3 cu. yds. dump trailers and it may be of interest to you to know what success we have had with them and how the operation cost compares with hauling by truck.

They have been used mainly by us in hauling Kentucky Rock Asphalt from the car to the road we have been constructing. Two Fordson Tractors were used each hauling one trailer loaded on an average with 4½ tons of Rock Asphault. Two trailers were being loaded at the cars while two were in transit. The route hauled over was dirt road for the most part and not in very good condition. Our average daily cost, including wages of driver, wear and tear on equipment, fuel and oil was $10.00; number of round trips per tractor per day was eight and length of haul was 3 miles. 4½ tons per load, hauled 3 miles, eight trips per day would make a total of 108 ton miles per day - cost of operation, $10.00 - cost per ton mile 9.26 cents.

Heretofore we have used trucks for this work and our average cost has been 15 cents per ton mile making a saving with tractor and trailers of 5.74 cents per ton mile.

We are very well pleased with these trailers and will advise that they have gone through the season in good shape, cost of repairs have been very light and they are in good condition.

Yours truly,
Mc Arthur Construction Co.
Per R. S. Frame Jr

Whitehead & Kales Co
Detroit Mich

ized as party, fire or division walls, shall be not less than 8 inches thick.

The maximum unsupported height of non-bearing partitions shall be as follows:

4 inches thick, exclusive of plaster, 15 feet
6 inches thick, exclusive of plaster, 20 feet
8 inches thick, exclusive of plaster, 25 feet

ARTICLE VIII
FOUNDATION WALLS

Section 39. *Foundation Walls*

1. Foundation walls for solid-wall construction shall be of brick, concrete, concrete block or stone. Solid brick foundation walls and those of concrete block or coursed stone shall be not less in thickness than the walls immediately above them and in no case less than 12 inches thick, except that when the enclosure is not excavated, they may be 8 inches thick if included within the allowable height of 8-inch walls. When built of concrete cast in place, foundation walls shall be at least as thick as the walls supported, but in no case less than 8 inches. When built of rubble stone they shall be at least 16 inches thick. Rough or random rubble without bonding or level beds shall not be used as foundations for buildings over 35 feet high nor shall coursed bonded rubble walls be so used for buildings exceeding 75 feet in height.

2. Foundation walls for hollow building tile, hollow concrete block, hollow walls of brick or frame construction may be built of solid brick, concrete, concrete block, hollow walls of brick, or except as special cases may arise, of salt-glazed tile or vitrified fire-clay tile with special thick walls and low degree of absorption. Tile foundation walls shall be not less than 12 inches thick.

3. When the stresses due to earth pressure and superposed building load exceed the maximum working stress elsewhere specified for brick masonry, the wall thickness shall be increased to bring them within these limits. See Appendix, par. 25.

4. Foundation walls for frame construction shall extend at least 8 inches above the adjoining ground surface.

ARTICLE IX
PANEL OR ENCLOSURE WALLS

Section 40. *Panel Walls*

Panel walls in buildings of skeleton construction shall be not less than 8 inches thick if of solid brick, clay hollow building tile, hollow concrete block, mass concrete, or hollow walls of brick. Panel walls constructed of metal fabric on steel supports, and plastered not less than 2 inches thick with cement plaster shall be allowed in lieu of 8-inch walls.

(To be continued in the April issue)

Improvements in Road Finisher

Machines May Now Be Run by Gasoline Power or by Hand Power with Ease

AMONG the new products and improvements in concrete road machinery during 1923, is the Heltzel concrete road finisher, which has been improved so that it may be run either by its own power or by hand power in case engine trouble should develop. The machine averages in weight with other machines on the market, but little effort is required to operate it by hand when necessary to do so, as only two men are necessary. When the engine is used only one man is needed.

AN IMPROVED CONCRETE ROAD FINISHER WHICH MAY BE OPERATED BY POWER OR BY HAND

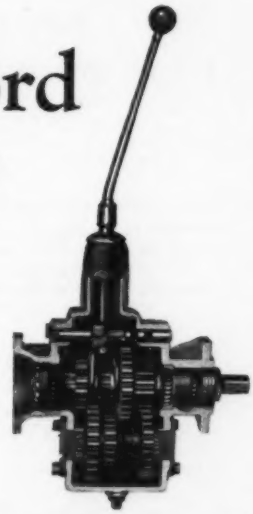
The machine has several speeds forward and backward which are independent of the engine. The strike-off is raised by eccentrics, and it also has a lateral motion of from 4 to 8 inches, requiring only one passage over the concrete. The strike-off actually compresses the concrete, as the blades work from a pivot attached underneath the eccentric straps. This makes the strike-off travel in an arc, the compression being from ⅛- to 3/16-inch, or just about the amount of actual settling required to make a dense concrete slab.

The machine is made by the Heltzel Steel Form & Iron Company, Warren, Ohio, and is provided with a tamp and belt, as well as the strike-off. Any one of these members may be either operated or idled as desired. The tamp is provided with levers, making it possible to strike a hard or a soft blow at will. All of the controls are on either side of the finisher. In going around curves, either end may be thrown out of gear to facilitate movement.

Another important feature of the Heltzel finisher is that any contractor can change the machine to a wider or a narrower width without dismantling. All machines, no matter what width they may be, can be narrowed down to 8 feet. Thus, in case it is necessary to build a 16-foot road in two sections, the work can be done with this finisher, as it is so designed that the wheels and flanges can be reversed to run inside the forms. For transporting the finisher from the car, all that is necessary is to run the car on its own wheels, which are provided for transportation purposes. These wheels are taken off or put on at will, as it is not necessary to dismantle any part of the machine. Care in the construction of this finisher makes it practically impossible for it to run off the forms, and, further, the machine requires an engine of only half the power used on most other machines.

Makes Your Ford A Two-Ton Truck

Six Speeds for Your Ford



Two-ton ruggedness is built into the Ford truck.

Two-ton power is supplied by the famous Ford engine.

The Warford Auxiliary Transmission forges the link between the two, which makes the Ford truck a distinctively economical two-ton haulage unit.

The Warford-equipped Ford, with a speed for every condition of road and load, hauls with the best of them through heavy going and passes the rest of them on good roads.

Warford couples bull-dog strength and speedwagon fleetness with Ford dependability and economy.

If your Ford dealer hasn't the Warford transmission, write for our dealer list.

What the Warford Is and What It Does

The Warford Auxiliary Transmission is a high-grade gear shift of the approved sliding gear selective type which gives the Ford six speeds forward and three reverse.

The Warford transforms engine revolutions into rear axle torque at six different ratios, from 36 to 1 in low, to 5 to 1 in high, allowing the engine to run at normal speed whether the truck is traveling one mile an hour or thirty.

In adapting normal engine speed both to heavy hauling and high speed, the Warford saves wear and tear, loss of power and waste of gas and oil, caused by the racing motor.

Warford

AUXILIARY TRANSMISSION

The Warford Corporation, 44 Whitehall Street, New York

When writing to advertisers, please mention the Contractors' & Engineers' Monthly—Thank you

Miscellaneous Notes

Lockwood, Greene Moves New York Office

LOCKWOOD, GREENE & COMPANY, Inc., has announced the removal of its New York office to the Pershing Square Building, 100 East 42nd Street.

The Whittier Apartment, Chicago, Ill.

WE are indebted to the Truscon Steel Company, Detroit, Mich., for our front cover illustration, an interesting construction picture of the Whittier Apartment, Detroit, Mich., in which Truscon I-beam construction was used. Charles N. Agree was the architect for this work.

John L. Ford Joins Ford Meter Box Company

THE third son of E. H. Ford, President of the Ford Meter Box Company, Wabash, Ind., has joined that organization as a traveling salesman. John L. Ford graduated in 1920 from Purdue University as a chemical engineer. Immediately after leaving the University he became associated with the Worthington Pump & Machinery Corporation, in its Sales Department, and held that position until January 1 of this year.

Kalman Purchases Corrugated Bar Company

THE Kalman Steel Company, of Chicago, Ill., has announced its purchase of the Corrugated Bar Company of Buffalo. By this amalgamation, the Kalman Steel Company becomes one of the largest distributors of reinforcing steel bars in the United States. The combined companies will be operated under the name of the Kalman Steel Company. Possession of the Corrugated Bar Company plant was taken at once by the purchasing interests, and the necessary reorganization looking to actual operation by the Kalman Company will be accomplished very shortly.

The Corrugated Bar Company has been an important factor in the development of reinforced concrete construction, since its organization in 1892, and is widely known for its products, chiefly the corrugated bar. Its plants are located at Buffalo, N. Y.; Hammond, Ind.; Boston, Mass.; Philadelphia, Pa., and Augusta, Ga. The Kalman Steel Company since 1901 has been continuously active as a distributor of reinforcing steel and related products. Its plants are located at Chicago, Ill.; New York, N. Y.; Youngstown, Pa.; St. Paul, Minn., and Minneapolis, Minn.

The executive personnel of the enlarged Kalman Steel Company is as follows: President, Paul J. Kalman; Vice-President and General Manager, George E. Routh, Jr.; Assistant Vice-President, J. A. Cathcart; Treasurer, A. E. Pinard; General Manager of Sales, A. P. Clark; Chief Engineer, W. S. Thomson; and Eastern Sales Manager, L. O. Helgeson. The executive offices of the Kalman Steel Company are at 22 West Monroe Street, Chicago, Ill., but about April 1 will be moved to the Wrigley Building, Chicago. District sales offices have been established at Chicago, New York, Philadelphia, Boston, Atlanta, Buffalo, Detroit, Cleveland, St. Louis, Kansas City, St. Paul, Minneapolis, Pittsburgh, Milwaukee, Dayton, Syracuse, Hartford, Conn., and Danville, Va.

Fire at J. D. Adams Factory

ON February 1 a spark from an electric hoist in the painting department started a fire which burned a portion of the plant of J. D. Adams & Company, Indianapolis, Ind., manufacturers of Adams adjustable leaning-wheel graders and road-building and maintenance machinery. The loss on the buildings and material was practically covered by insurance. Before the smoke had been cleared away, plans were being drawn for a new building of fire-proof construction which will give this company a larger and more modern plant. Construction on the new building is already under way and is progressing rapidly.

Pending the completion of the new building, production is going forward in temporary quarters with very little interruption. There is sufficient finished stock in the Indianapolis warehouses and other warehouses throughout the country to take care of normal demands for two months, and enough semi-finished machines are being finished up immediately to take care of an additional month's business. No delay is expected in delivering orders promptly out of this stock, and before the reserve is exhausted, production will be at a point where it will be possible to fill orders throughout the year with no inconvenience to customers.

Blaw-Knox Announces New Plan to Finance Industrial Buildings

EXTENDED-PAYMENT plans have been applied to automobiles and household goods for the benefit of the public at large. To apply these fundamentals to manufacturing buildings costing from $1,000 to $50,000, as has been announced by the Blaw-Knox Company, Pittsburgh, Pa., puts the purchase of buildings for every use on a "pay for them as they earn for you" basis. A. C. Lehman, President of the Blaw-Knox Company, states that the need for such a plan has been evident for some time.

The Blaw-Knox building finance plan has been developed after many months of careful study by some of the most capable financial experts in the country. The service was not announced until it could be carried out big enough to adequately meet the need for it in a national way. Now, the Blaw-Knox Company will finance and supply the needed structure so that any business, large or small, may have the same extension of credit that they in turn extend to others.

Speed is vital to success in meeting demand and competition. Six months or a year has

usually been considered fast time for erecting big factory buildings. The best speed records of past years are made ridiculous by the short time required for erecting standard steel buildings to-day. Factories are available in 30 days. The first cost of building has been cut 50 per cent through standard shop production. Erection of standard steel sections is much faster and more economical than with smaller units. Scientific forming of the sheets gives strength and rigidity to a piece of otherwise flexible steel. Standard roof and wall sections are quickly attached to shop-made columns and trusses. Hole fits hole, bolts slip into place—a few turns of the wrench and all is complete.

It is almost impossible for an industry to-day to tell what will be needed to-morrow in the way of buildings. Additions are needed at the most unexpected times, even where the business is well managed. The flexibility of standard steel structures is another reason for their success. It is a decided advantage to have structures that can be enlarged quickly by ordering more standard units. Every business welcomes the fact that these additions can be made without waste.

The Blaw-Knox Company has announced a number of changes in its sales organization. Robert T. Harris, who has been located at the New York office, has been transferred to Baltimore, as District Sales Manager; Walter H. Duncan, formerly Field Engineer for John F. Casey Company, contractors, has joined the sales staff of the Road Equipment Department; William F. Glasser, formerly Engineer of the Heavy Forms Department, has been promoted to Assistant Chief Engineer of that department; Charles K. Wehn, formerly located at the Chicago office, has been transferred to the Pittsburgh office as District Manager of the Standard Steel Building Department; R. D. Spradling, who has been located at the Baltimore office, has been made District Manager of the Standard Building Department at Chicago; and Dan W. Healy remains at the New York office in the capacity of District Sales Manager of the Standard Building Department.

Book Reviews

LUMBER AND ITS USES

R. S. Kellogg, revised by Franklin H. Smith. U. P. C. Book Company, Inc., New York. 1924. Third edition. 585 pp. Illustrated. $4.

This book, through its revisions, aims to inform the user of lumber of the properties and uses of the principal American trees that are manufactured into lumber. It should be studied in conjunction with the recent U. S. Department of Agriculture Pamphlet 296 on the standardization of yard lumber grading, and is a particularly helpful reference volume. It deals with the grades of lumber, the standard sizes of lumber, lumber and log measurements, shipping weights, structural timbers, the seasoning of timber, wood preservation, paints and wood finishes, wood block paving, hardwood flooring the fire resistance of various types of wood, lumber prices and comparative building costs, the various uses of lumber, the commercial woods, the manufacture of lumber, and the timber supply.

DESIGNING HEATING AND VENTILATING SYSTEMS

Charles A. Fuller, Consulting Engineer, U. P. C. Book Company, Inc., New York. 1923. Second edition, revised and enlarged. 245 pp. Illustrated. $3.00.

While this book was developed mainly as a textbook for vocational and trade schools, it makes an excellent reference book for the contractor or engineer who is facing problems in the design or installation of heating and ventilating systems. It is replete with illustrations, diagrams and helpful tables, and thoroughly covers the subject in a practical, understandable manner.

DAMP WALLS

By E. G. Blake, Member of Royal Sanitary Institute. D. Van Nostrand Company, New York. 1923. VIII + 248 pages, 68 illustrations. Price $3.00.

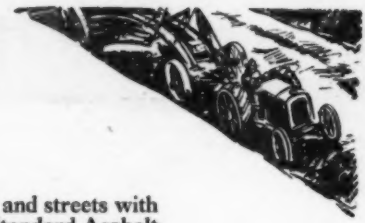
From the American contractors' standpoint the only unfortunate points about this book are that the terminology is distinctly that of the British Isles and a large number of British patented compounds and insulating materials are mentioned, rather than American products. This is perfectly natural, as the author, an Englishman, is well versed in the products of his own country. In spite of these handicaps, this book by E. G. Blake, who is well known for other books in the building field, contains a wealth of material, helpful to the designer, as well as the contractor in preventing the production or accumulation of dampness within or upon the walls of various types of buildings. The early chapters of the book take up the causes and effects of dampness, and temporary remedies, both internal and external. Following this is a discussion of permanent remedies, and then the question of prevention of dampness in cellars is discussed. The subject of condensation, a trial which is unfortunately met very frequently in the now popular stucco building construction, is dealt with in a concise, but complete, manner. Methods of waterproofing portland cement, of brick and of water-proof building construction, and the use of the monolithic concrete system and the separate unit concrete system, are described at some length. This is a very helpful book for the small contractor who is called in to remedy accumulations of dampness within building structures.

Watch Your Asphalt Specifications

Apparently some highway officials and consulting engineers have not fully realized that, beginning January 1, 1924, manufacturers, in accordance with the recommendations adopted at the Asphalt Paving Conference held by the Department of Commerce, are making asphalt of only nine definite penetration limits for the construction of sheet asphalt, asphaltic concrete and asphalt macadam pavement and for surface treatments, and four penetration limits for joint fillers and various other types of construction, including brick and granite block pavements.

Engineers and street and highway officials in some instances are still specifying other than the thirteen definite limits which have been set. In this way they are increasing the price which the manufacturer must charge for the special asphalt, because the refining processes and storage of asphalt are now standardized for the grades agreed upon.

Improve your Roads *at* Low Cost



Repair and improve your roads and streets with Stanolind Paving Asphalt and Standard Asphalt Road Oil. The cost of application is small. No special mixing machinery is necessary. In twenty-four hours, or at the most, forty-eight hours after the work is finished, the road can be opened to traffic. You will find that one or both of these products can be used to advantage in improving almost any type of pavement.

For Building Up Your Dirt and Stone Roads

You can protect and greatly improve ordinary dirt and stone roads by applying the right grade of Standard Asphalt Road Oil at the right time, in the right way. By starting this year to build up the road, in four or five years you will have ready an excellent base for the higher types of asphalt pavements.

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If you have brick pavements which are getting too rough for comfortable traveling they can be relaid —economically—with Stanolind Paving Asphalt. At a comparatively low cost, you will thus put the pavement in shape for many more years of service.

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Dirt and stone roads which have been treated with the right grade of Standard Asphalt Road Oil for a period of four or five years, may be converted easily into a paved highway by applying a seal coat of the right grade of Stanolind Paving Asphalt. You will then have a wearing course which, at a minimum cost of upkeep, will give satisfactory service for several years.

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Without cost or obligation to you a Standard Road Engineer will be glad to advise you on the proper grades of asphalt to use for your roads and the best and most economical way to apply it. Write our nearest branch or direct to

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THE following cards (arranged by states) show the names of dealers in contractors' equipment and supplies with a record of the various lines handled. Contractors will find this list a convenient means of getting in touch with dealers who make a point of giving satisfactory service and prompt shipments. This directory is constantly consulted by our subscribers and any suggestions regarding it will be welcomed. *. *. *.

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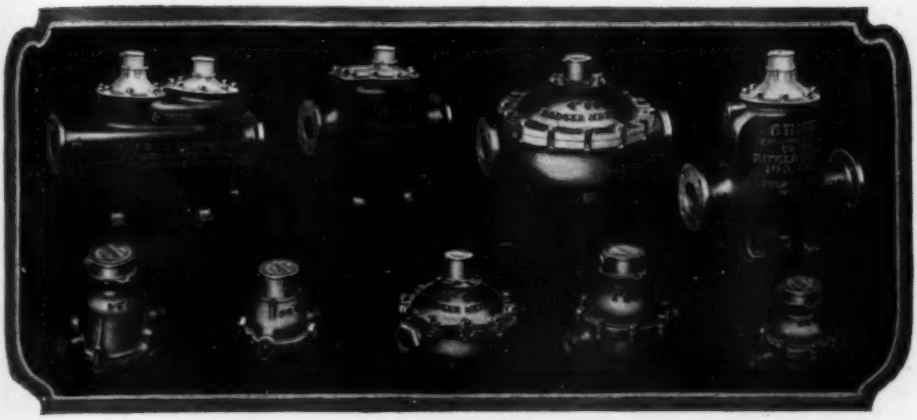
Advertisement for Bids to Construct

A Sanitary Sewerage System and Sewage Disposal Plant for the Borough of Elizabethtown, Penna.

Sealed Proposals endorsed "Proposals for Constructing a Sanitary Sewerage System and Sewage Disposal Plant at Elizabethtown, Pa." addressed and delivered to D. L. Landis, Sec'y of Borough Council, Elizabethtown, Pa., will be received until Tuesday, April 15, 1924, at 7:00 P. M., at which time the bids will be publicly opened at a meeting of Borough Council at their usual meeting place in said Borough. In general the work to be done involves a Disposal Plant, four trunk sewer lines approximately 21,900 ft. long, a collecting system of laterals in Borough Streets approximately 51,000 ft. long, incidental manholes, flush tanks, appliances, etc. Largest size pipe used is 15-inch. Plans and specifications and other information can be secured upon application to F. H. Shaw, C.E., No. 53 North Duke Street, Lancaster, Pa., or Fuller & McClintock, No. 1001 Chestnut Street, Philadelphia, Pa. The Borough reserves the right to reject any and all bids. Bids may be for the whole, or any one of six parts of the whole, as per specifications.

By authority of Borough Ordinances approved March 5th and 11th, 1924.

D. L. LANDIS,
Secretary Borough Council.



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